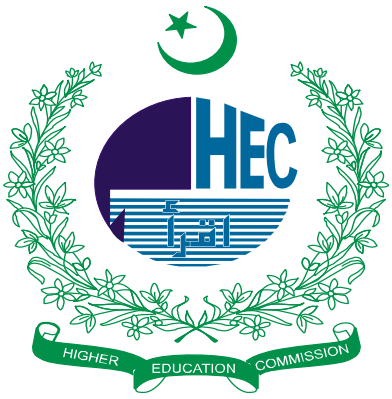
CURRICULUM

OF

METALLURGY AND MATERIALS ENGINEERING

BS/BE/BSc
&
MS/ME/MSc

2012



HIGHER EDUCATION COMMISSION
ISLAMABAD

CURRICULUM DIVISION, HEC

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PREFACE

The curriculum of subject is described as a throbbing pulse of a nation. By viewing curriculum one can judge the stage of development and its pace of socio-economic development of a nation. With the advent of new technology, the world has turned into a global village. In view of tremendous research taking place world over new ideas and information pours in like of a stream of fresh water, making it imperative to update the curricula after regular intervals, for introducing latest development and innovation in the relevant field of knowledge.

In exercise of the powers conferred under Section 3 Sub-Section 2 (ii) of Act of Parliament No. X of 1976 titled **"Supervision of Curricula and Textbooks and Maintenance of Standard of Education"** the erstwhile University Grants Commission was designated as competent authority to develop, review and revise curricula beyond Class-XII. With the repeal of UGC Act, the same function was assigned to the Higher Education Commission under its Ordinance of 2002, Section 10, Sub-Section 1 (v).

In compliance with the above provisions, the HEC undertakes revamping and refurbishing of curricula after regular intervals in a democratic manner involving universities/DAIs, research and development institutions and local Chamber of Commerce and Industry. The intellectual inputs by expatriate Pakistanis working in universities and R&D institutions of technically advanced countries are also invited to contribute and their views are incorporated where considered appropriate by the National Curriculum Revision Committee (NCRC).

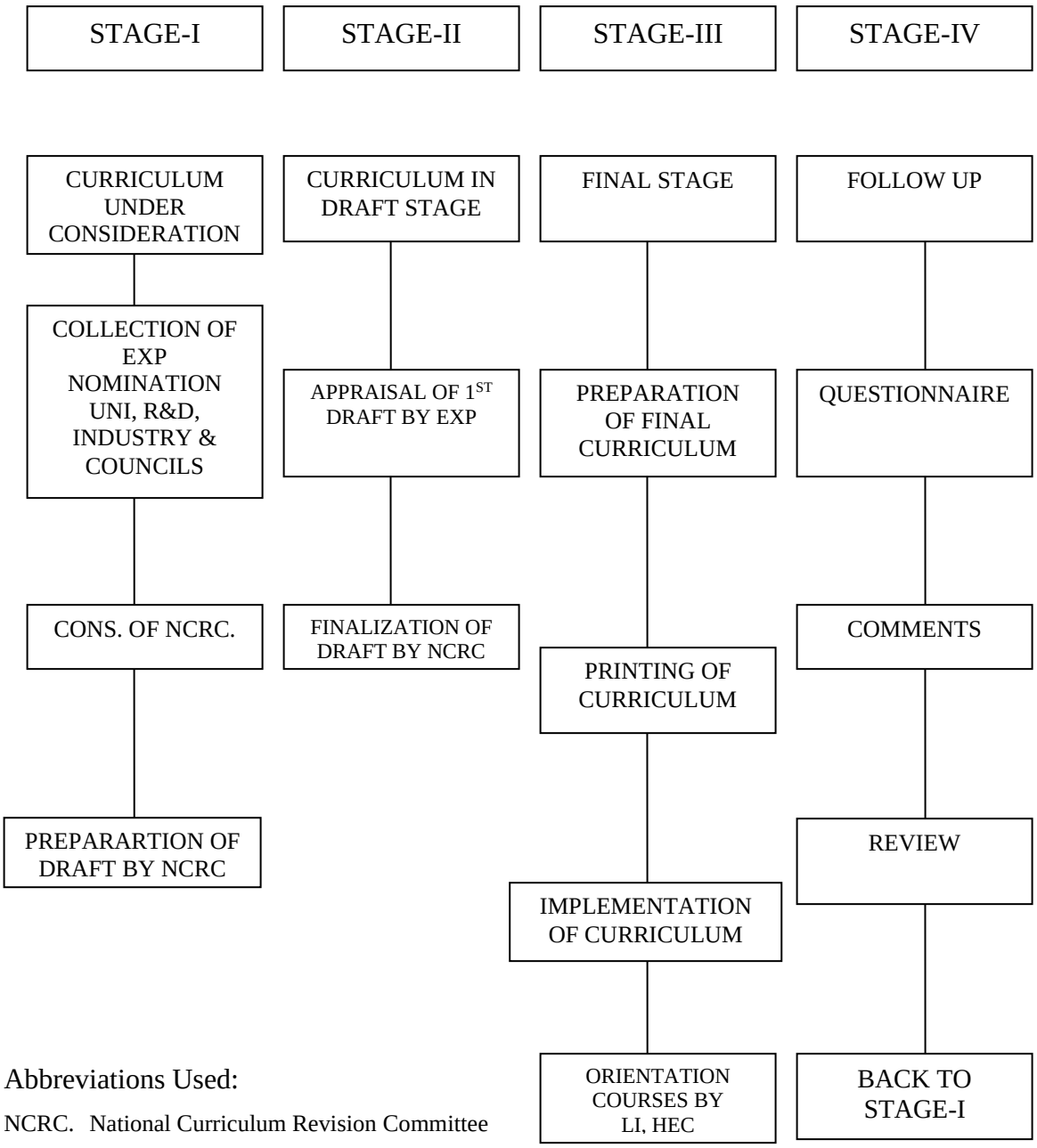
A committee of experts comprising of conveners from the National Curriculum Revision Committees of HEC in the disciplines of Basic, Applied, Social Sciences, Agriculture and Engineering met in 2007 & 2009 and developed the unified templates to standardize degree programmes in the country so as to bring the national curriculum at par with international standards, and to fulfill the national needs. It also aimed to give a basic, broad based knowledge to the students to ensure the quality of education.

In line with above, NCRC comprising senior university faculty and experts from various stakeholders and the respective accreditation councils has finalized the curriculum for Metallurgy and Materials Engineering. The same is being recommended for adoption by the universities/DAIs channelizing through relevant statutory bodies of the universities.

MUHAMMAD JAVED KHAN
Adviser (Academics)

April, 2012

CURRICULUM DEVELOPMENT



Abbreviations Used:

NCRC. National Curriculum Revision Committee

VCC. Vice Chancellor's Committee

EXP. Experts

COL. Colleges

UNI. Universities

PREP. Preparation

REC. Recommendations

LI Learning Innovation

R&D Research & Development Organization

HEC Higher Education Commission

Introduction

The National Curriculum Revision Committee (NCRC) of Metallurgy and Materials Engineering had two meetings held on 16-18 November 2011 and 14-16 March 2012 at the Higher Education Commission Regional Centre, Karachi to revise and develop the curriculum for BE/BS and ME/MS degree programme. The committee consisted of the following members:

1.	Prof. Dr. Fazal Ahmad Khalid, SI Pro-Rector (Academic) GIK Institute of Engineering Sciences and Technology, Topi Khyber Pakhtunkhwa	Convener
2.	Prof. Dr. Mohammad Mujahid Dean and Principal School of Chemical and Materials Engineering (SCME), NUST Sector H-12, Islamabad	Member / Secretary
3.	Prof. Dr. Muhammad Nasim Department of Metallurgical & Materials Engineering, Dawood College of Engineering & Technology, MA Jinnah Road Karachi – 74800	Member
4.	Prof. Dr. M. Saleem Shuja Rector The University of Lahore, Lahore	Member
5.	Prof. Dr. M Hayat Jokhio Department of Metallurgy and Materials Engineering Mehran university of Engineering and Technology Jamshoro, Sindh	Member
6.	Dr. Muhammad Faisal Rathore Manager (NESCOM Nominee) Project Management Organization (PMO) Expert Engineering, Opposite EME College Peshawar Road, Rawalpindi	Member
7.	Engr. M. Sajid Ali Asghar Assistant Professor Department of Materials Engineering NED University of Engineering & Technology University Road, Karachi - 75270	Member

8. Dr. Muhammad Kashif Khan — Member
Manager
Mechanical & Aerospace Engineering
Structural Laboratory, System Engineering
& Design Division
St. Wing, SUPARCO Plant
HUB River Road, Karachi

9. Prof. Dr. Mazhar Mehmood — Member
Principal Engineer / Head of Department
Department of Metallurgy and Materials
Engineering, Pakistan Institute of Engineering
and Applied Sciences (PIEAS)
Nilore, Islamabad

10. Prof. Dr. Muhammad Shahid — Member
Head Department of Materials Engineering
School of Chemical and Materials Engineering
NUST, Islamabad

11. Prof. Dr. Muhammad Afzal Khan — Member
Department of Mechanical Engineering
HITEC University, Taxila Cantt

12. Dr. Umair Alam — Member
Assistant Professor
Department of Metallurgical Engineering
NED University of Engineering & Technology
University Road, Karachi - 75270

Mr. Muhammad Javed Khan, Adviser, Academics Division, Higher Education Commission (HEC) welcomed the members and participants to the meeting. He briefed the members on the academic programme and activities of the Higher Education Commission (HEC) and highlighted the important aspects related to national policy and guidelines for revision of curricula in all disciplines.

Prof. Dr. Fazal Ahmad Khalid, SI, the Convener thanked the Higher Education Commission (HEC) and members for providing an opportunity to participate and contribute in the revision of curriculum on Metallurgy and Materials Engineering. He highlighted the important benchmarks and international best practices to be considered for the development of the curriculum. He also suggested that the Committee comprising professors and experts from academia, industry and R&D institutions will provide a useful input and suggestions to incorporate in the curriculum. He also highlighted the importance of the field of materials engineering for development of new and advanced materials and mineral processing for economic development of the country. It is envisaged that the revised curriculum will provide

universities broad guidelines and benchmark to adopt in certain fields of specializations and research, for the education and training of graduates and engineers.

PROGRAMME AND EDUCTAIONAL OBJECTIVES

The main objective of this curriculum is to provide the guidelines for the following programs:

1. Metallurgy & Materials Engineering
2. Materials Engineering
3. Metallurgical and Materials Engineering
4. Metallurgical Engineering

The graduates are expected to demonstrate knowledge, competence and expertise in materials and metallurgical processes, structure-property relations, design and analytical techniques. Graduates should also have following attributes:

a. Strong fundamental background
b. Broad based engineering knowledge
c. Problem solving approach
d. Suitability to work effectively in the industry
e. Dynamic leadership, effective communication skills, high moral values and good engineering ethics.
f. Creative and innovative thinking for research and development.
g. Sufficient skills to optimise human, technological and natural resources

PROGRAMME LEARNING OUTCOMES

The curriculum has been reviewed in order to produce academically sound graduates for being successful in industry, research and development, international companies. Apart from the engineering courses a sufficient number of courses in English language, communication skills, ethics, social and management sciences have been incorporated into the curriculum to enhance the quality and performance of the graduates.

It is also expected that having followed this curriculum, the graduates would be sufficiently equipped to successfully pursue post-graduate studies.

SALIENT FEATURES

The curriculum revision is based on following considerations:
The undergraduate programme has been revised on the basis of HEC and PEC directives. The salient features of the revised curriculum are given below:

Duration:	4 years
Number of Semesters	8
Number of weeks per semester:	18 (16 for teaching and 2 for

	examinations)
Total number of credit hours:	136
Number of credit hours per semester:	15 – 18
Engineering Course:	69.12
Non-Engineering Course (Maximum):	30.88

This entire curriculum has been designed on the following lines:

- The curriculum matrix is composed of the foundation, breadth and depth courses so that different streams for specializations can be developed within each discipline.
- Foundation courses: The foundation courses are the compulsory courses. These courses provide students with the fundamental concepts and tools to pursue their studies at the higher level.
- Breadth Courses: The breadth courses introduce different specialties in the given discipline of engineering early in their studies comprising courses related to major based core breadth (MBCB) and Interdisciplinary engineering breadth courses (IDEB)
- Depth Courses: The depth courses offer various streams within each programme. All depth courses must integrate a substantial design component.
- The students may select electives from any of the streams with some guidelines from their respective advisors.
- All courses are also identified as engineering or non-engineering.
- A university can offer a degree programme in:
    - Metallurgy & Materials Engineering
    - Materials Engineering
    - Metallurgical and Materials Engineering
    - Metallurgical Engineering

The universities/institutions may opt for a particular engineering programme (1-4) considering the mission of the programme learning outcomes (PLOs) and availability of faculty and requisite lag facilities and infrastructure.

This curriculum has been designed to facilitate the universities to formulate their programmes according to the industrial needs and recent development in the field of Materials Science and Engineering.

FRAME WORK TEMPLATE FOR BE/BSc/BS METALLURGY AND MATERIALS ENGINEERING									
Non-Engineering Domain								**% Area**	**% Overall**
Knowledge Area	**Subject Area**	**Name of Course**	**Lec CH**	**Lab CH**	**CR**	**Total Courses**	**Total Credits**		
Humanities	English	Communication Skills	3	0	3	2	6		
		Technical Report Writing and Presentation Skills	3	0	3				
	Culture	Pakistan Studies	2	0	2	2	4		
		Islamic Studies/Ethics	2	0	2				
	Social Sciences	Social Science I	3	0	3	2	6		
		Social Science II	3	0	3				
Management Sciences (MS)		**Select Any Three Courses**							
		Industrial Safety and Environmental Engineering	3	0	3	3	9		
		Production Operations Management	3	0	3				
		Environmental Management and Control	3	0	3				
		Entrepreneurship & Marketing	3	0	3				
		Solid Waste Management	3	0	3				
		Metallurgical Plants and Quality Control	3	0	3				
		Total Quality Management (TQM)	3	0	3				
		Engineering Management	3	0	3				
		Energy Management	3	0	3				
Natural Sciences (NS)	Physics	Applied Physics	3	1	4	1	4		
	Mathematics	Calculus	3	0	3	3	9		
		Differential Equations, linear algebra and Applied Techniques	3	0	3				
		Statistical Methods and Estimation	3	0	3				
	Chemistry	Applied Chemistry	3	1	4	1	4		
SUB TOTAL						**14**	**042**	**100**	**30.88**

Engineering Domain								% Area	% Overall
Knowledge Area	**Subject Area**	**Name of Course**	**Lec CH**	**Lab CH**	**CR**	**Total Courses**	**Total Credits**		
Computing	Fundamentals	Introduction to Computing	2	1	3	3	9		
	Programming	Numerical Analysis	3	0	3				
	Design	Computer Applications in Materials Engineering	2	1	3				
Engineering Foundation (EF)		Engineering Drawing and graphics	2	1	3	9	30		
		Workshop Practice	1	1	2				
		Introduction to Engineering Materials	3	0	3				
		Mechanical Behaviour of Materials	3	1	4				
		Physical Metallurgy-I	3	1	4				
		Materials Thermodynamics	3	0	3				
		Inspection and Testing of Materials	3	1	4				
		Instrumentation and Control	3	1	4				
		Engineering Mechanics	3	0	3				
Major Based Core Breadth (MBCB)		Heat Treatment	3	1	4	7	26		
		Physical Metallurgy-II	3	1	4				
		Ferrous Metallurgy	3	0	3				
		Non Ferrous Metallurgy	3	0	3				
		Engineering Ceramics and Glasses	3	1	4				
		Manufacturing Technology	3	1	4				
		Polymeric Materials	3	1	4				
		Elective Courses							
Major Based Core Depth (MBCD		Advanced Materials	3	1	4	5	20		
		Welding and Joining Processes	3	1	4				
		Foundry Engineering	3	1	4				
		Corrosion Engineering	3	1	4				
		Materials Characterization	3	1	4				
		Powder Metallurgy	3	1	4				
		Surface Engineering	3	1	4				
		Advanced Steels	3	1	4				
		Design and Selection of Materials	3	1	4				
		Composite Materials	3	1	4				
		Biomaterials	3	0	3				
		Fracture Mechanics and Failure Analysis	3	1	4				
Inter-disciplinary Engineering Breadth (IDEB)		**Elective Courses**				1	3		
		Furnaces and energy conservation	3	0	3				
		Mineral Processing	3	0	3				
		Nuclear Materials	3	0	3				
		Vacuum Technology	3	0	3				
Senior Design Project		Senior Design Project Part-I	0	3	3	2	6		
		Senior Design Project Part-II	0	3	3				
Industrial Training			0	0	0	0	0	0	0
SUB TOTAL						**27**	**94**	**100**	**69.12**
GRAND TOTAL						**41**	**136**		**100**

Summary				
Domain	**Knowledge Area**	**Total Courses**	**Total Credits**	**% Overall**
Non-Engineering	Humanities	6	16	30.88
	Management Sciences	3	9	
	Natural Sciences	5	17	
	Sub Total	**14**	**42**	
Engineering	Computing	3	9	69.12
	Engineering Foundation	9	30	
	Major Based Core (Breadth)	7	26	
	Major Based Core (Depth)	5	20	
	Inter-Disciplinary Engineering Breadth (Electives)	1	3	
	Senior Design Project	2	6	
	Industrial Training	0	0	
	Sub Total	**27**	**94**	
Grand Total		**41**	**136**	**100**

In the existing curriculum matrix, the labs are attached with the courses however, the universities may have the flexibility to combine different experiments of the semester as an independent lab course with appropriate credit hours.

Scheme of Study
for BE/BSc/BS Metallurgy and Materials Engineering

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
First Year (1st semester)				**First Year (2nd semester)**			
Communication Skills	3	0	3	Engineering Drawing and CAD	2	1	3
Applied Physics	3	0	3	Workshop Practice	1	1	2
Calculus	3	0	3	Introduction to Engineering Materials	3	0	3
Introduction to Computing	2	1	3	Engineering Mechanics	3	0	3
Applied Chemistry	3	0	3	Pakistan Studies	2	0	2
Islamic Studies/Ethics	2	0	2				
				Differential Equations and Applied Techniques	3	0	3
Total	**16**	**1**	**17**	**Total**	**14**	**2**	**16**
First year Credit Hours	**33**						

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
Second Year (3rd semester)				**Second Year (4thsemester)**			
Technical Report Writing and Presentation	3	0	3	Mechanical behaviour of Materials	3	0	3
Engineering Economy(Social Science)	3	0	3	Engineering Ceramics and Glasses	3	1	4
Numerical Analysis and Computer Programming	3	1	4	Ferrous Metallurgy	3	0	3
Materials Thermodynamics	3	0	3	Physical Metallurgy-II	3	1	4
Physical Metallurgy-I	3	1	4	Social Psychology and Human Rights (Social Science)	3	0	3
Total	**15**	**2**	**17**	**Total**	**15**	**2**	**17**
Second year Credit Hours	**34**						

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
Third Year (5th semester)				**Third Year (6th semester)**			
Polymeric Materials	3	1	4	Manufacturing Technology	3	1	4
Heat Treatment	3	1	4	Inspection and Testing of Materials	3	1	4
Management Science Elective I	3	0	3	Inter Disciplinary Elective I	3	0	3
Corrosion Engineering	3	1	4	Composite Materials	3	1	4
Non-ferrous Metallurgy	3	0	3	Computer Applications in Materials Engineering	2	1	3
Total	**15**	**3**	**18**	**Total**	**14**	**4**	**18**
Third year Credit Hours	**36**						

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
Final Year (7th semester)				**Final Year (8th semester)**			
Welding and Joining Processes	3	1	4	Inter Disciplinary Elective	3	0	3
Entrepreneurship and Marketing	3	0	3	Management Science Elective	3	0	3
Statistical Methods and Estimation	3	0	3	Advanced Materials	3	1	4
MBCD-Elective	3	0	3	MBCD Elective	3	1	4
Senior Design Project Part-I	0	3	3	Senior Design Project Part-II	0	3	3
Total	**12**	**4**	**16**	**Total**	**12**	**5**	**17**
Final year Credit Hours	**33**						
Total Credit Hours	**136**						

DETAIL OF COURSES
BE/BSc/BS LEVEL

Title of the Course: **English-I (Functional English)**
Credit Hours: 3-0-3
Course Outline: **Annex-A**

Title of the Course: **English-II (Communication Skills)**
Credit Hours: 3-0-3
Course Outline: **Annex-A**

Title of the Course: **English-III** (**Technical Report Writing and Presentation Skills)**
Credit Hours: 3-0-3
Course Outline: **Annex-A**

Title of the Course: **Pakistan Studies**
Credit Hours: 2-0-2
Course Outline: **Annex-B**

Title of the Course: **Islamic Studies/ Ethics**
Credit Hours: 2-0-2
Course Outline: **Annex-C**
Lab Outline: N/A
Recommended Books:

Title of the Course: Social Science (Social Psychology and Human Rights)
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: The impart knowledge of social psychology of attraction; attitudes and prejudice; altruism and aggression; personal and social identities; conformity; group influence and their applications in the real world.

Course Outline:
Principles of sociology and psychology with emphasis on the individual and his/her reciprocal interaction with groups, basic psychological factors, attribution and perception of others, attitudes and attitudinal change, social attitudes, altruism, helping others, aggression, hurting others, prejudice, disliking others, discrimination and stereotypes, language and communication, society and cultures, culture and personality, small groups and their relation to the individual, leadership and group dynamics. Attraction, attitudes and prejudice; altruism and aggression; personal and social

identities, conformity, group influence, moral and ethical issues, harassment, corruption and its control, thinking processes and decision making.

Lab Outline: N/A

Recommended Books:

- Edward Alsworth Ross, “Social Psychology”, Macmillan, 2006
- Emory Stephen Bogardus, “Essentials of Social Psychology”, Univ. of Southern
  California Press, 2006
- Hewstone, M., & Stroebe, W. (Eds.), “Introduction to Social Psychology”, 3rd ed.,
  Oxford: Blackwell Publishers, 2006
- Lesko, W.A. “Readings in social psychology General, classic, and contemporary selections, 6th ed., 2006

Title of the Course: Social Science (Engineering Economy)
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To impart knowledge of engineering economy.

Course Outline:

Introduction of engineering economy and the economic environment. Consumer and producer goods, measures of economic worth, Price, Supply, & Demand relationship; Production; Factors of production; Laws of return. Cost Concepts & Analysis: Sunk & opportunity costs; Fixed, variable, and incremental costs; Recurring & nonrecurring costs; Direct, indirect, and overhead costs; Standard costs; Unit cost of production. Time Value of Money: Simple interest; Compound Interest; Cash flow diagrams; Interest formulas; Nominal versus effective, interest rates; Depreciation and Depletion: Purpose of depreciation; Types of depreciation; Production Concepts & Mathematical Models: Manufacturing lead time, Production rate; Capacity; Utilization; Availability; Work in process; Linear Programming: Mathematical statement of linear programming problems; Graphic solution; Simplex method; Duality problems. Capital Financing and Budgeting: Types of ownership; types of stock; partnership & joint stock companies; Banking & specialized credit institutions. Industrial Relations: Labour problems; Labour organizations; Prevention & Settlement of disputes.

Lab Outline: N/A

Recommended Books:

- George Owen Hoskins and Thomas Hall Burnham, “Engineering Economy”, Pitman, 2007

- William Thomas Morris, “Engineering Economy”, University of Michigan Jan, 2007
- Paul, E. Degarmo, “Engineering Economy”, OUP, 2005
- John Charles and Lounsbury Fish, “Engineering Economics”, McGraw-Hill, 2005

Title of the Course: **Industrial Safety and Environmental Engineering**

Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To provide thorough knowledge of industrial safety and engineering environment.

Course Outline:

Industrial safety management, Understanding accident and hazard, Hazard control and loss control. Accident Prevention and Control, Accident reporting and investigation, Fire safety, Electrical Safety, Safety in boilers, Safety in material handling and storage, Safety in production operations. Process Safety Management: Development of facility operation and procedures, Analysis of process hazard. Hazard communication, Chemical inventory record. Industrial Hygiene and Workers Protection, Various hazards encountered in workplace, Types of personal protective equipment (PPE), Availability in market their design standards and selection criteria. Environment Management: Environment pollution, Air emission management, Waste management, Waste water treatment and control, Soil and ground water protection, Introduction to Pakistan Environment Protection Act 1997 and National Environmental Quality Standards, Key elements of ISO 14000.

Lab Outline: N/A

Recommended Books:

- Thomas J. Anton, “Occupational Safety & Health Management”, 2nd ed., McGraw Hill, 2006
- Daniel E. Della-Giustina, **“**Safety and Environmental Management”, 2001
- Ronald Packman, “A Guide to Industrial Safety and Health” Longmans, 2007
- James S. Angle, “Occupational Safety”, Thomson Delmar Learning, 2004, ISBN 1401859038

Title of the Course: Production Operations Management
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To provide insight in the management skills to the engineers working in the production industry.

Course Outline:

Production /operation functions and the organization. Basic concepts of five Ps .Production strategies, guides and unities. Decision making in operations. Planning and controlling operations. Operational budget making and controlling. Variety management. Quality control and quality management. TQM.
Location, design and layout of plant and equipment. Maintenance of equipment.
Methods study and work measurement. The importance of forecasting in production and operations control. Project management techniques. Personnel management. Health and safety management in industry

Lab Outline: N/A

Recommended Books:

- Keith Lockyer, "Production and Operations Management", Pitman, ELBS ed., 2000.
- Lockyer, K. G., "Production Control in Practice", Pitman, 2007
- Norman Gaither, "Production and Operation Management", Dryden Press, 2007
- William Gavett Harcourt, "Production and Operation Management", Brace & World, 2006
- John F. and Muth, Gene K. Groff, "Operation Management", Irwin, 2007
- Buffa, Elwood Spencer, "Modern Production Management" Wiley, 2006, ISBN 0471118230
- Nicholas J. Aquilano, Richard B. Chase, "Production and Operation Management" , Irwin, 2007,

Title of the Course: Environmental Management and Control
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To provide thorough understanding of environmental management and its control.

Course Outline:

Environmental Organization, Legislation, Standards, Monitoring and Compliance assurance, Environmental Economies, Regional Development Planning, Environmental Decision-Making for industries.

NEQA, ISO-14000 and Occupational Safety and Hazards Regulations. Risk Analysis. Atmospheric Dispersion of Pollutants. Analysis of Control Systems for Gaseous and Particulate Emissions. Discussion of Source Control and Air Quality Standards, Environmental Quality Objectives, Environmental Legislation, Standards, and Technologies. Interrelations of Air, Water Pollutions Environmental Pollution Control.

Lab Outline: N/A

Recommended Books:

- Christopher J. Barrow, "Environmental Management & Control" Rutledge, 2006
- Stephen. Tinsley, "Environment Management", Taylor & Francis, 2001, ISBN 0415246636
- Bhaskar Nath, "Environment Management in Practice", Rutledge, 1999, ISBN 041514907X
- Frank B. Friedman, "Practical Guide to Environmental Management", Environmental Law Institute, 2003, ISBN 1585760471

Title of the Course: Solid Waste Management
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To provide knowledge of solid waste management produced by materials industry.

Course Outline:
Solid wastes definitions, characteristics and perspectives. Types of solid wastes, sources of solid waste management. Engineered systems for solid waste management Solid waste generation, on site handling, storage and processing. Collection of solid wastes, Transfer and transportation, processing techniques, ultimate disposal. Engineered systems for resource and energy recovery, processing techniques, materials recovery of biological conversion products, recovery of energy from conversion products and energy recovery systems. Plastic waste, composition quantities and disposal alternatives. Recycling of wastes, recycling of plastics, metals and glasses.

Lab Outline: N/A

Recommended Books:

- Johan Post "Solid Waste Management", Springer, 2004, ISBN 1402019750
- Elizabeth M. Thomas-Hope, "Solid Waste Management", Canoe Press University of the West Indies, 1998, ISBN 9768125438
- Elizebeth, M Thomas-Hope "Solid Waste Management" 1998

- Forbes, R. McDougall, “Integrated Solid Waste Management” Black Well Publishing, 2001, ISBN 9780632058891

Title of the Course: Metallurgical Plants and Quality Control
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To provide knowledge of metallurgical plants and the quality control procedures used.

Course Outline:

Metallurgical plant location, Factors affecting location; Multiplant location; Plant layout; product and process layout analysis; Layout comparison. Type of Pollutants and their treatment, Overview of Environmental impacts of Iron and Steel making, Hot rolling, Forging, Cold rolling, Annealing and Tempering, Coating and Plating plants. Environmentally friendly metallurgical plants. Occupational Health and Safety Impacts of Metallurgical plants. Basic procedures and remedies. Applications of computers for environmental and Pollution Control and Waste management in metallurgical plants. Fundamentals of statistics and analysis techniques. Probability distributions. AQL, AOQL, L TPD, attributes sampling, variable sampling, selection of proper sampling plan. Reliability and maintainability, inspection of different types of materials and products for evaluation of quality reliability of flaw detection by non-destructive inspection, quality control applications of non-destructive inspection. Introduction to standards. Familiarization of standards for testing of materials, ASTM, BS, JIS GOST and ISO. Pakistan Standards, Quality assurance for final products, Measures for quality control.

Lab Outline: N/A

Recommended Books:

- Tim Jones, “Steel Industry and the Environment: Technical and Management issues”, International Iron, Steel Institute, ISBN: 9280716514, 2000.
- Mular Andrew L, Barrett, Derek J., and Halbe Doug N., **“**Mineral Processing Plant Design, Practice, and Control**,”** Society for Mining Metallurgy & Exploration, 2002.
- Kasatkin, N. L, **“**Erection and Operation of Metallurgical Plant**”** Mir, 1975.
- Nurse M. C, Brown Sharon, **“**Metallurgical Plant Makers of the World**”,** Metal Bulletin Books; 4th ed., 1997.
- Coppa & Avery Consultants, **“**Metallurgical Plant Design**”,** Vance Bibliographies 1985.
- Metals Handbook Vol. 17th, “Non-destructive Testing and Quality Control”, American Society for Metals USA, 2005.

Title of the Course: Applied Physics
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To provide in-depth knowledge of the subject.

Course Outline:

Thermometry, heat transfer, heat insulation, properties of materials for use in building geometrical optics, the focal length of a lens, magnification, compound lenses, resolving power, laws of illumination and photometry, sextant spectrometer. Principles of refracting telescope, polarization of light. Waves and oscillation, sound waves, resultant to two simple harmonic motions, response and beats, acoustics and its application, interference, wave length and frequency, units and measurement of intensity, reflection and refraction of sound, reverberation time. Magnetic effect of current, CGS and practical units, relation between magnetism and electricity, magnetic field due to current in a long wire, force on a current carrying conductor in magnetic field, laws of electromagnetic induction, galvanometer, ammeter, voltmeter, avometer, condensers and dielectrics, Magnetic materials, B-H curves, hysteresis, magnetic circuits calculations, solenoids, pull of an electromagnet, principles of diode & triode, cathode ray tube and photo-multiplier tube. Atomic & nuclear physics, atomic structure, nuclear structure, radioactivity, nuclear theory, fission & fusion.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Halliday and Resnik, “Fundamentals of Physics”, Willey, 2010
- Ewen and Nell “Applied Physics” Prentice Hall, Ed. 10, 2011
- Stan Gibilisco, “Applied Physics”, McGraw-Hill, 2002, ISBN 0071382011
- Arthur Beiser, “Applied Physics”, McGraw-Hill, 4th Ed., 2004 ISBN-10: 0071426116
- John. D. Cutnel, “Physics” Wiley; 8th ed., 2009,
- Douglas, C., Giancoli, “Physics Principles and Applications”, Pearson Education, 2004, ISBN-10: 0131846612

Journals/Periodicals
World Wide Web

Title of the Course: Calculus
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To build the basic calculus and analytical geometry background.

Course Outline:

Basic Operations of complex numbers, De'Moivre's Theorem with applications, Circular, Hyperbolic, Exponential Functions of complex numbers and their inverse functions.

Limits-Indeterminate forms, Continuity, differentiability, Total differential with applications to errors, Newton's method of approximating roots of non-linear equations. Tracing of simple curves in Cartesian and Polar Coordinates, Curvature and radius of curvature. Partial differentiation with applications. Homogeneous functions. Tangent and normal. Review of basic integration methods. Application to Area, Arc Length, Volume and Surface of Revolution. Reduction formulae. Elementary Beta and Gamma integrals. Rectification and Quadrate. Centre of gravity. Centre of pressure. Moment of inertia of plane areas. Approximate integration. Scalar and Vector quantities, physical and geometrical meanings. Algebra of vectors. Scalar and vector triple products.

Lab Outline: N/A

Recommended Books:

- William, E., Boyce Richard, and Diprima, C., "Calculus", John Wiley, 2006ISBN: 0471093335
- Richard Courant and Fritz John, "Introduction to Calculus and Analysis" Springer, 2000, ISBN 3540665706
- Steven George Krantz, "Calculus Demestified" , McGraw-Hill, 2002, ISBN 0071393080
- Edmund Landau, "Differential and Mathematical Calculus", American Mathematical Society, 2001, ISBN 0821828304
- Douglas D. Downing, "Calculus", Barron's Educational Series, 1996, ISBN 0812091418

Title of the Course: Differential Equations, linear algebra and Applied Techniques

Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: Develop fundamental skills of solving ordinary differential equations, and developing differential equations for real-world problems.

Course Outline:

Applications of simple convergence tests such as comparison, root, ratio, Raabe's and Gauss' tests on the behaviour of series. Definitions, formation and solution. Boundary conditions. Homogeneous and Non-homogeneous linear differential equations with constant coefficients, linear equations will variable coefficients. Cauchy's and Legendre's equations. Equations of second order. System of simultaneous linear equations with constant

coefficients. Numerical approximation to solutions. Solution in Series. Simple applications in Engineering. Orthogonal trajectories. Formation of partial differential equations. Solution of first order linear and special types of second and higher order differential equations used in Engineering problems. Various standard forms. Elementary transformations. Shifting Theorems. Heaveside's expansion formula. Simple applications. Limit, continuity, zeros and poles, Cauchy-Reimann Equations, conformal transformations, contour integration. Rectangular Coordinate Systems in three dimension, direction cosines, plane (straight line) and sphere. Taylor's Theorem for functions of two variables without proof. Maxima and minima of functions of two variables. Lagrange's method of multipliers. Double integration, change of order, conversion to polar form. Applications in finding areas, volumes, centroids, centre of pressure. Movement of inertia and principal axes. Theorems of Pappus and Guldinus. Surface area and volumes of revolution. Differentiation of vectors, gradient, divergence and curl. Laplacian and spherical harmonies. Vector integration. Theorems of Gauss, Green and Stokes. Simple applications. Linearity, dependent and independent vectors, bases and dimension, vector spaces, fields, linear transformations, matrix of a linear transformation. Basic definitions and matrix operations, adjoin and inverse of a 3 x 3 matrix. Rank of a matrix. Cayley-Hamiltion Theorem, eigen values. Applications in solving linear homogeneous and non-homogeneous equations in three unknowns. Cases of existence of solution, no solution, infinite and unique solutions. Cartesian Tensors, understanding

Lab Outline: N/A

Recommended Books:

- Richard Bronson, "Differential Equations", McGraw-Hill, 2003, ISBN 007140967X.
- Van Groesen, E. W. C. and Soewono, E. "Differential Equations" Springer, 2003, ISBN 0792348311.
- Zill, Prindle, "A First Course in Differential Equations", Cole Publishing, 2001. ISBN: 0534955746.
- Edwards, C. H. and David, E., "Penney Elementary Differential Equations with Applications", Prentice Hall, 1993. ISBN: 0132534282.
- Constantine M. Dafermos, C. M., "Differential Equations" , CRC Press, 2000, ISBN 0824780779.
- Peter B. Kahn, "Mathematical Methods" Courier Dover Publications, 2004, ISBN 0486435164.
- Howard Anton, "Elementary Linear Algebra" 7th ed., John Willey, 1993.
- Sadri Hassani, "Mathematical Methods", Springer, 2000, ISBN 0387989587.
- Carl M. Bender, Steven A. Orszag "Advanced Mathematical Methods for Engineers", Springer, 1999 ISBN 0387989315.

Title of the Course: **Applied Chemistry**
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To provide thorough understanding of chemistry which is essential for Materials/Metallurgical engineers.

Course Outline:

Introduction to chemistry, its scope and importance in Metallurgy and Materials Engineering. Classification of elements, periodic table and electronic configuration. State of matter (gas, liquid, solid) kinetic theory of gases, solutions. Basic laws: Roult's law, Henry's law, Sievert's law, Law of diffusion. Theory of crystallization, atomic bonding, crystal systems, properties of solid, liquid and gases. Chemical equilibrium: Chemical reaction and equilibrium, chemical kinetics, theory of electro-chemistry, heterogeneous equilibrium, phase-rule, quantum theory. Introduction to oxidation and reduction reactions in iron and steel making Oxygen potential diagrams. Organic chemistry: Introduction, nature and sources of compounds, hydrocarbon compounds, chemistry of hydrocarbon compound cracking. Introduction to biochemistry, Analytical chemistry: Introduction, qualitative and quantitative analysis of ferrous and non ferrous metals, analysis of various ores, coals, liquid solution, Introduction to analytical instrumentation

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Shultz, "Chemistry for Engineer" Brookes Cole, 1st Ed, 2006.
- Fahlman, "Materials Chemistry", Springer, 2nd Edition, 2011.
- Hyman D. Gasser, "Applied Chemistry", Springer 2002Edward Andrew Parnell, "Applied Chemistry", D. Appleton & Co., 2007
- Thodore E. Brown, "Chemistry", Prentice Hall, 2005 M. Farhat, "Industrial Chemistry", McGraw-Hill 2004 Journals/Periodicals

World Wide Web

Title of the Course: **Statistical Methods & Estimation**
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To introduce the concept of statistics, randomness and probability and build on these concepts to develop tools and techniques to work with random variables

Course Outline:

Statistical treatment of data, frequency distribution and graphs, measures of central tendency, measures of variation. Probability, samples, spaces and

events, counting probability, the axioms of probability, some elementary theorems, conditional probability, Bay's theorem, mathematical expectation and decision making. Probability distribution, random variables, the binomial distribution, Poisson approximation to the binomial distribution, Poisson processes, probability densities, normal distribution, statements "T" distribution. Sampling distribution, populations and samples. Curve fitting regression analysis by least square method, correlation, linear, polynomial, power, regression analysis by least square method, incorporation of linear polynomial, exponential or power function. Correlation coefficient of determination. Application and exponential model of reliability and life testing.

Lab Outline: N/A

Recommended Books:

- Jyotiprasad Medhi "Statical Methods", New Age Publishers, 2005, Kenneth. Lange, "Statical Methods", Springer, 2002, Montgomery, D.C., and Runger, G. C., "Applied Statistics and Probability for Engineers", John Wiley & Sons, 2001
- N. A. Weiss, "Introductory Statistics", Addison Wesley, 1995

Journals/Periodicals
World Wide Web

Title of the Course: Introduction to Computing
Credit Hours: 2-1-3
Pre-requisites:

Specific Objectives of Course: This course focuses on a breadth-first coverage of computer: introducing software engineering and information technology.

Course Outline:

Number Systems, Binary numbers, Boolean logic, History and basic components of computer system, approaches to solving problems using computers, Von Neumann Architecture, Algorithm definition, design, and implementation, Programming paradigms and languages, basic elements of C++ language, programming practice and case studies Graphical programming, Overview of Software Engineering and Information Technology, Operating system, Compiler, Computer networks and internet, Computer graphics, AI, Social and legal issues.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- O. Leary "Computing Essentials 2012", McGraw-Hills, 22nd Edition 2011.

- Andrew J. Herbert, Roger Michael Needham, “Computer Systems”, Springer, 2004.
- Glenn, H. MacEwen, “Introduction to Computer Systems”, McGraw-Hill, 2007.
- John A. Aseltine, “Introduction to Computer Systems”, Wiley, 2007, Neil A. B. Gray “Introduction to Computer Systems” Prentice-Hall 1987.

Journals/Periodicals
World Wide Web

Title of the Course: Numerical Analysis
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To enable students using structured programming techniques in suitable programming languages and implement numerical solutions using computer-based techniques.

Course Outline:

Numerical Analysis: Finite difference and theory of interpolation, iterative methods for collocation polynomials, Approximate zeros (roots) Numerical integration and differentiation. Interactive methods for solution of linear systems, Design value problems, Numerical solutions of ordinary differential equations. Basic Computer Concepts: Computer history, main types of computer, Number Systems, Field of Computer applications, Input/Output and Control processing units. Flow Chart Techniques: Main features of an efficient programming, How to organize the problem, Representation of various operations in flow-charts, Computer Programming: Kinds of computer languages, Arithmetic operators and priorities constants and types of their expressions.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Mathew and Fink, “Numerical Methods” Prentice Hall, 2004
- Chopra and Canale “Numerical Methods for Engineers” McGraw-Hill, 2009
- Zhilin Li, Lubin and Vulkov, Jerzy Waśniewski, “Numerical Analysis and its Applications”, Springer, 2005, ISBN 3540249370
- Michelle Schatzman, “Numerical Analysis” Oxford University Press, 2002, ISBN 0198508522
- Steven T. Karris, “Numerical Analysis” Orchard Publications, 2004, ISBN 0974423912

Journals/Periodicals
World Wide Web

Title of the Course: **Computer Application in Materials Engineering**

Credit Hours: 2-1-3
Pre-requisites:

Specific Objectives of Course: To provide knowledge of applications of computer in Materials engineering.

Course Outline:

Basic computer modelling and simulation techniques, Computer modelling and simulation of blast furnace and basic oxygen converter operations. Computer modelling for microstructures, Phase transformation, mechanical properties and materials processing including rolling, forging, casting, extrusion and machining operations. Use of computer software such as MATLAB, solidcast, magma, material studio, MTdata, CALPHED, FEM software such as ANSYS, ABACUS.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Mark F. Horstemeyer, Integrated Computational Materials Engineering (ICME) for Metals: Using Multiscale Modelling to Invigorate Engineering Design with Science, Wiley-TMS 2012.
- June Gunn Lee, Computational Materials Science: An Introduction, CRC Press 2011.
- P. V. Roy and S. Haridi, “Concepts Techniques and Models of Computer Programming”. MIT Press, 2004
- ASTM Series “Computer Application in Materials Engineering”, 2000
- Tetsuya Saito, “Computational Materials Design”, December 2010
- June Gunn Lee, “Computational Materials Science: An introduction”, 1st Edition, September 2011
- Koenread George Frans Janssens, Dierk Raabe, Ernest Kozeschnik, Mark A. Miodownik, Britta Nestler, “Computational Materials Engineering: An Introduction to Microstructure Evolution”, first ed, 2007
- Celyustkin, A.B., “The Application of computing Technique to Automatic Control Systems in Metallurgical Plant”, Mac Milan, 2004
- National Research Council (USA) “Computer Aided Materials Selection” National Academies Press 1995
- ASTM Series “Computer Application in Materials Engineering”, ASTM, 1990

Journals/Periodicals
World Wide Web

Title of the Course: Engineering Drawing and Graphics
Credit Hours: 2-1-3
Pre-requisites:

Specific Objectives of Course: To provide in-depth knowledge of engineering drawings and graphics.

Course Outline:

Introduction to subject, use of instruments, Planning of drawing sheets, the projection of simple solids in simple position, the oblique and auxiliary plans, lettering, dimensioning, the principle requirement of working drawing. Geometrical drawing & graphics: Isometric and pictorial of solid figures, making of free hand sketches from solid project and from orthographic projections. Section of solid, tangent planes, two surface in contact, intersection of surface and interpretation of solids development of surfaces.
Machine drawing: Screw thread systems, keys and cutters, coupling and simple bearings, hanger, wall bracket, pipes and pipes fittings, shafts, connecting rods, piston and piston rod, valves stuffing boxes, pulling thread gearing.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Thomas Ewing French “Engineering Drawing” McGraw-Hill 2006
- Henry Loren Thompson, “Engineering Drawing Practice and Theory and Practice”, International textbook company, 2007
- Charles William Weick “Elementary Mechanical Drawing” McGraw-Hill, 2006
- Frederick Ernest Giesecke, “Engineering Graphics”, Prentice Hall, 2003 Journals/Periodicals

World Wide Web

Title of the Course: Workshop Practice
Credit Hours: 1-1-2
Pre-requisites:

Specific Objectives of Course: To impart knowledge of workshop techniques.

Course Outline:

Bench fitting: Description, proper use and maintenance of the fitting tools: use and care of measuring instruments, Preparation of some specific jobs. Forging: Hand forging, Use and maintenance of forging tools, the fore anvils, hammers, chisels, fullers, swages, punches, drifts, tongs, Prepare some specific jobs using forging methods. Use of power hammer, drop and press forging, riveting. Wood working: Use & care of wood working tools, clamps, saws, planes, files, rasps, chisels, drills, bits, planning, nailing, screwing, jointing, doweling. Use and care of natural wood, chipboard, plywood,

hardboard etc. Safety and care: Precautions necessary in many shops machine accidents, general cleanliness of shop, proper appraisal, accident alarms and evacuation.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Alfred Parr Longmans, “Workshop Practice”, Green, and co, 2007
- Henry Wright Baker, “Modern Workshop Technology”, Cleaver-Hume Press, 2006
- Alfred Parr Longmans, “Machine Tools and Workshop Practice” Green & Co. 2007
- Raymond Francis Yates “Model Making Including Workshop Practice” The Norman W. Henley publishing company, 2007
- S. K. Garg, “Workshop Technology”, Laxmi Publication’s 2005, ISBN 8170086353

Journals/Periodicals
World Wide Web

Title of the Course: **Introduction to Engineering Materials**
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To introduce type of materials used in engineering.

Course Outline:

Introduction to engineering materials, their scope and role in industrial development, raw materials for engineering materials: their availability and demand, Atomic bonding, Crystal structures of metals, Introduction to polymers, ceramics and composite materials. Processing, properties and applications of metallic, polymeric, ceramic and composite materials. An introduction to new breeds of engineering materials e.g., shape memory materials, smart materials, biomaterials, electrical, magnetic and optical materials. Materials of aerospace and transportation industries.

Lab Outline: N/A

Recommended Books:

- William D. Callister, David G. Rethwisch, Fundamentals of Materials Science and Engineering: An Integrated Approach, Wiley 2012
- William D. Callister, David G. Rethwisch, “Fundamentals of Materials Science and Engineering: An Integrated Approach”, 4th Edition, November 2011
- Callister, “Materials Science and Engineering : An Introduction”, John Wiley and Sons, 8th Edition, 2009

- Donald R. Askeland, Pradeep P. Fulay, Wendelin J. Wright, “The Science and Engineering of Materials”, 6th Edition, June 2010
- William Smith, Javad Hashemi, “Foundations of Materials Science and Engineering”, 5th Edition, April 2009
- Ashby, M. F. and Jones, D.R.H., “Engineering Materials-I & -II”, Butterworths- Heinemann, 2005
- Charles, J. A., “Selection and Use of Engineering Materials”, Butterworth-Heinemann, 2001
- Smith, W. F., “Structure and Properties of Engineering Alloys”, McGraw-Hill, 2001
- Flinn, R. A. and Trojan, P. K., “Engineering Materials & Their Applications”, Houghton Mifflin, 2002
- Lewis, G., “Selection of Engineering Materials”, Prentice Hall, 2000

Journals/Periodicals
World Wide Web

Title of the Course: Mechanical Behaviour of Materials
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To develop knowledge of mechanics of materials.

Course Outline:

Mechanism of plastic deformation, Theory of dislocations, Theory of elasticity, brittle fracture. Unsymmetrical bending and shearing. Horizontal shearing stresses, shear flow, flow deflection due to shear, photoelastic method. Plasticity, relationship between stress and deformation, moment of inertia along different axes. Ellipse of inertia, determination of principal axes.. Introduction to stress strain diagram, working stresses strain energy in tension and compression. Analysis of bi-axial stresses, principal planes, principal of stress-strain curves, stresses in thin walled pressure vessels. Mohr’s circles of bi-axial stress. Torsion of circular shafts, strain energy in shear and torsion of thin walled tubes. Thermal stresses, buckling, failure of materials under static and dynamic loading.

Lab Outline: N/A

Recommended Books:

- Richard W. Hertzberg, Richard P. Vinci, Jason L. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, Wiley 2012.
- Joachim Roesler, Harald Harders, Martin Baeker, Mechanical Behaviour of Engineering Materials: Metals, Ceramics, Polymers, and Composites, Springer 2010
- George Dieter, Mechanical Metallurgy SI Metric Edition, McGraw-Hill, 1988

- Courtney “Mechanical Behaviour of Materials”, Waveland Pr inc. 2005
- Marc André Meyers (Author), Krishan Kumar Chawla, “Mechanical Behaviour of Materials”, Cambridge University Press; 2nd Edition , 2008 Dieter, “Mechanical Metallurgy” McGraw-Hill.
- Benham, P. P., Crawford, R. J. and Armstrong, J. P., “Mechanics of Engineering Materials”, Pitman, 2000 or latest edition
- Beer, Johnsten, DeWolf, Mazurek, “Mechanics of Materials”, McGraw-Hill, 2011.
- Madhukar Vable, “Mechanics of Materials”, OUP, 2002.

Journals/Periodicals
World Wide Web

New Course: **Engineering Mechanics**

Credit Hours: 3-0-3

Statics of Particles:

Forces in a plane; Newton’s First Law, Free body diagram; Forces in space (rectangular components); Equilibrium of a particle in space.

Kinematics of Particles:

Rectilinear and curvilinear motion of particles; Components of velocity and acceleration; Motion relative to a frame in translation.

Kinetics of Particles:

Newton’s Second Law; Dynamic equilibrium; Rectilinear and curvilinear motion; Work and energy; Kinetic energy of particle; Principle of Work and Energy; Conservation of energy; Impulse and momentum; Impulsive forces and conservation of momentum; Impact, direct and oblique; Conservation of angular momentum.

Rigid Bodies:

Equivalent systems of forces; Principle of transmissibility; Moment of a force; Couple; Varignons Theorem. Centre of gravity of a three-dimensional body and centroid of a volume. Moments of inertia, radius of gyration, parallel axis theorem.

Equilibrium of Rigid Bodies:

Free-body diagram; Equilibrium in two and three dimensions; Reaction of supports and connections; Equilibrium of two-force and three-force bodies.

Kinematics of Rigid Bodies:

General Plane motions; Absolute and relative velocity and acceleration.

Plane Motion of Rigid Bodies:

Forces and acceleration; Energy and momentum; Conservation of linear and angular momentum.

Friction:

Laws of dry friction; Angles of friction; Wedges; Square-threaded screws; Journal and thrust bearings; Belt friction.

Analysis of Structures:

Internal forces and Newton’s Third Law; Simple and space trusses; Joints and sections; Frames and machines. Forces in cables.

Recommended Books:

- R. C. Hibbeler, “Engineering Mechanics (Statics)” 12th Edition, 2009
- J. L. Meriam and L. G. Kraige “Engineering Mechanics (Statics)” Wiley, 2011

Title of the Course: **Physical Metallurgy-I**
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To develop understanding of physical metallurgy of materials.

Course Outline:

generation of x-ray diffraction methods, Stereo graphic projections, generation of x-ray, crystallography, crystal defects (point defects, line defects) and their importance, Crystallography; Space lattice, Crystal system, Unit cell, Packing density, Coordination number, Allotropy, Rotational and Reflection Symmetries, Crystal planes and direction, Crystalline defects, Twining, Ordered and Disordered solutions. Crystallization; Solidification, Grain boundaries, Grain size,

Recommended Books:

- William F. Hosford, Physical Metallurgy, 2nd Edition, CRC Press 2010
- Reza Abbaschian, Robert E. Reed-Hill, Physical Metallurgy Principles – SI Version 4th Edition, CL Engineering 2009
- Reed Hill, R. E. and Abbaschian, R., “Physical Metallurgy Principles”, 3rd Edition, PWS, 2008 .
- Sydney, H. Avner, “Introduction to Physical Metallurgy”, McGraw-Hill, 2001.
- Cahn, R. W. and Haasen, P., “Physical Metallurgy”, North-Holland, 2001.
- Honeycombe, R. W. K., and Bhadeshia, H. K. D. H., “Steels, Microstructures and Properties”, Edward Arnold, 2005.
- Smallman, R. E. and Bishop, R. J., “Modern Physical Metallurgy and Materials Engineering”, Butterworth-Heinemann, 1999.
- Hammond “The basics of Crystallography and Diffraction” Cambridge Press, 2001
- B. D. Cullity and Stock, “Elements of X-ray Diffraction”3rd Edition, 2001

Physical Metallurgy II

Credit Hours: 3-1-4

Phase transformation and control of microstructures, martensite formation, interfaces and grain boundaries. Phase diagrams; Phase rule, Binary system, Ternary system, Solid Solution, Interstitial solid solution and Substitutional solid solution, Factor affecting the limit of solubility, Intermediate compound, Mixture, Iron -Carbon Diagram, Microstructure and properties of steel and Cast Iron, Microstructure of Copper based and Aluminum based alloys and their relationship to the properties, Metallurgical Microscope, Objective lenses and their short comings, Polarized light microscopy, Solidification, Cast structure, Segregation, Shrinkage defects, Driving force for phase transformation, Diffusional studies, self-diffusion, Volume and grain boundary diffusion. Free energy changes during phase transformation, Concept of Gibbs's free energy, Critical radius. Liquid-solid and solid-solid transformation. Nucleation & growth, homogeneous and heterogeneous nucleation, nucleation on crystalline defects and on grain boundaries. Precipitation reactions, GP zones, Intermediate and stable precipitate, Coherency strain, Volume free energy, strain free energy, Spinodal decomposition, diffusional and diffusionless transformation, iron carbon phase diagram.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Porter, D. A and Easterling, K.E, "Phase Transformations in Metals and Alloys", Chapman & Hall, 2001.
- Honeycombe, R. W. K., and Bhadeshia, H. K. D. H., "Steels, Microstructures and Properties", Edward Arnold, 2005.Polmear, L.J., "Light alloys- Metallurgy of the Light Metals", 3rd ed., Arnold, 1999.
- Cahn and Haasen, "Physical Metallurgy" 2001
- William F. Hosford, *University of Michigan, Ann Arbor, USA*, "Physical Metallurgy, Second Edition", 2010 .
- Christian, J. W., "Transformations in Metals and Alloys", Pergamon Press, 1975
- Martin, Doherty and Canter, "Stability of Microstructures in Metallic Systems" Cambridge University Press, 1997

Journals/Periodicals
World Wide Web

Title of the Course: **Materials Thermodynamics**
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course:

Course Outline:
First law of thermodynamics, enthalpy, internal energy. Second law, entropy, Third law Gibbs and Helmoltz free energies. Use of thermodynamic data. Equilibrium, quasi-static equilibrium. Relationship between heat and work. Reversible and irreversible processes. Measurement of heat reactions, Phase equillibria in single and multicomponent systems. Behaviour of solutions, non-ideal solutions, thermodynamics of phase diagrams. Experimental methods of evaluating thermodynamics functions, estimation and calculation of the values of thermodynamic functions, free energy of formation, free energy diagrams. The Arrhenius equation, the activated complex theory, collision theory, calculation of reaction rates. Heterogeneous reactions, gas-solid reactions, liquid-solid reactions, liquid-liquid reactions at slag-metal interface, gas-liquid reactions.

Lab Outline:N/A

Recommended Books:
- Y. Austin Chang, W. Alan Oates, “Materials Thermodynamics (Wiley Series on Processing of Engineering Materials”, first ed, December 2009
- Gaskell, D. R , “Introduction to the Thermodynamics of Materials”, Taylor and Francis, 5th Edition, 2008
- Kaufman. M., “Principles of Thermodynamics”, CRC, 2002
- David Ragone, “Materials Thermodynamics” MIT Press, 2002
- Machlin E. S., “An Introduction to Aspects of Thermodynamics & Kinetics”, Giro Pr; 2nd Edition, Dec 2001
- Hudson, J. B, “Thermodynamics, An Advanced Text for Materials Scientists”, John-Wiley, 1996

Journals/Periodicals
World Wide Web

Title of the Course: **Inspection and Testing of Materials**
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To provide thorough understanding of inspection and testing of materials

Course Outline:
Introduction to inspection and testing of materials, its scope and importance, The Brinell test, the Vicker test, the Rockwell test, the Knoop test, the

Scleroscope test, conversion tables for various scales of hardness, Stress and strain, load extension diagrams, modulus of elasticity, elastic limit, yield stress, proof stress, work hardening, tensile testing, (equipment and specimens). Compression testing, bend testing, torsion testing. impact testing. Toughness, brittleness and ductility, notched bar impact testing, the Charpy and Izod impact tests, brittle and ductile fractures, The fatigue test, different types of fatigue fractures, Goodman diagram, endurance limit-ultimate tensile strength, The Creep Test. Non destructive testing of materials, Liquid Penetrant, Eddy Current, X ray, Magnaflux, Ultrasonic, Radiography. ASTM, ASME, ISO standards and certifications and practices used for materials testing and inspection.

Lab Outline: Lab Manuals will be available in the concerned laboratory.

Recommended Books:

- Chuck Hellier, Handbook of Nondestructive Evaluation, 2nd Edition, McGraw-Hill Professional 2012
- Dieter G. E., "Mechanical Metallurgy", McGraw-Hill, 2002.
- Hertzberg R. W., "Deformation and Fracture Mechanics of Engineering Materials", John-Wiley, 2000
- Collins J. A., "Failure of Materials in Mechanical Design", John-Wiley, 2000
- Halmshaw R., "Non- Destructive Testing", 2nd Edition, Edward Arnold, 2000.
- Felbeck D. K. and Atkins, A. G., "Strength and Fracture of Engineering Solids", Prentice-Hall, 2000.
- Hull J. B. and V. B. John, "Non-Destructive Testing", Macmillan, 1988.

Journals/Periodicals
World Wide Web

Title of the Course: **Instrumentation and Control**
Credit Hours: 3-1-4
Pre-requisites: -

Specific Objectives of Course: To provide knowledge about the instrumentation and control systems used in materials and metallurgical engineering

Course Outline:

The functional elements of instruments, Pyrometry, Active and passive transducers, Calibration, Accuracy, Sensitivity, Threshold, Resolution, Hysteresis and Dead Space, Linearity, Permanent Magnet Moving coil instrument, Pen recorder, Cathode ray Oscilloscope, Transistor as Amplifier, Measuring instruments for motion, pressure, level, temperature and heat flux, Optical pyrometers, rheotubes, temperature recorders, digital portable temperature indicators, analog temperature controllers, types of

thermocouples, pressure gauges, flow meter and flow gauges, Introduction to open loop and closed loop control systems, Dynamics of first and second order system. Lapalace Transform, Transfer Function, Stability, steady State error and its elimination, Introduction to frequency response techniques. Electromechanical relay, Silicon controlled rectifier, Servo Motor, Logic Gates (NOR AND NAND).

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- NJATC, "Fundamentals of Instrumentation" Delmer Cengag learning, 2008
- Clair Bayne "Applied Electricity and Electronics" Goodheart-Willcox Pub, 2004 Stan Gibilisco "Teach Yourself Electrical and Electronics" McGraw-Hill 2001
- Randy Slone, G., "Electricity and Electronics" McGraw-Hill ,2000,
- John Park, Steve Mackay, "Instrumentation and Control System", Newness, 2003
- Walt Boyes, "Instrumentation Reference Book", Elsevier, 2003,

Journals/Periodicals
World Wide Web

Title of the Course: **Heat Treatment**
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course:

Course Outline:

Phase diagram and their applications, Effect of common alloying additions on the equilibrium diagram. Annealing, normalizing, oxidation and decarburization during heat treatment, quenching rates and quenching media, martensitic transformation, TTT diagrams, effects of austenizing, grain size and alloying element on the transformation diagram, CCT diagrams. Hardenability, austempering, martempering. Induction and Flame hardening, heat treatment of cast iron, heat treatment of non ferrous metal and alloys, age hardening/precipitation hardening, defects caused during heat treatment and their remedies and subzero treatment, surface treatment and surface engineering.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Mats Hillert, "Phase Equilibria, Phase Diagrams and Phase Transformation: Their Thermodynamic Basis", 2nd Edition, December 2007

- L. Dossett and H. E. Boyer, “Practical Heat Treating: Second Edition”, ASM International, 2006.
- Harry Bhadeshia , Robert Honeycombe, “Steels: Microstructure and Properties”, Butterworth-Heinemann; 3rd Edition, 2006.
- George E. Totten, *Portland State University, Oregon, USA, “*Steel Heat Treatment: Equipment and Process Design*”, CRC,* September 28, 2006.
- Totten, G. E., “Steel Heat Treatment”, CRC, 2007
- Krauss, G., “Steels Heat Treatment & Processing”, ASM, 2000
- Martin, J. W., “Precipitation Hardening”, IoM, 1996

Journals/Periodicals
World Wide Web

Title of the Course: Engineering Ceramics and Glasses
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: to understand processing, design composition, learn about microstructure-property relationship of ceramic materials.

Course Outline:

Classification of ceramic materials, traditional Ceramics, Glass-ceramics, , Ceramics Microstructure, Review of Bonding and Structural Principles, Phase Equilibria, Batch Calculations, Raw Materials & Powder Processing, Forming, Densification, Physical, Thermal, electrical and Mechanical Behaviour of ceramics, , Ceramics Industry in Pakistan, refractories and their applications. Special ceramics, electro ceramics. Types of Glasses, Glass transition, heat treatment of glasses, glass formability and glass production techniques.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- David Richerson, “Modern Ceramic Engineering: Properties, Processing, and Use in Design, Third Edition”, CRC Press; 3rd Edition , 2005.
- James F. Shackelford (Editor), Robert H. Doremus, “Ceramic and Glass Materials: Structure, Properties and Processing”, Springer; Softcover reprint of hardcover 1st Edition, 2008 edition, 2010.
- Kingery, Bowen, Uhlmann “Introduction to Ceramics” Wiley, 1976
- Rice, R. W., “Ceramic Fabrication Technology”, Marcel Dekker, 2003
- Bengisu, M., “Engineering Ceramics”, Springer, 2001
- Richerson, D. W., “Modern Ceramic Engineering”, Marcel Dekker, 2000
- Terpstra, R. A., Pex, P. P. A. C. and de Vries, A. H., “Ceramic Processing”, Chapman & Hall, 1995
- Lee, W. E. and. Rainforth, W. M., “Ceramic Microstructures: Property Control by Processing”, Chapman and Hall, 1994

- Rawson H “Glasses and their Applications”, Royal Institute of Metals, London 1991
- J. E. Shlby “Introduction to glass science and technology” Royal Society of Chemistry, 2nd Edition, 2005.

Journals/Periodicals
World Wide Web

Title of the Course: **Manufacturing Technology**
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To understand manufacturing processes available for materials.

Course Outline:

Scope and importance of manufacturing technology in Pakistan, Classification of mechanical working processes, Stamping and Deep Drawing, Weldability, work hardening, forging, tube drawing, sheet metal forming process, machining, rolling principles, rolling of ingot, bloom, billets, sheet and structural components, rolling of bars and rods, thermo-mechanical Treatment, rolling mills design and calculations, manufacturing process and system design, manufacturing defects causes and remedies, quality control in manufacturing processes, CAD/CAM technology. Introduction to Non-conventional manufacturing processes such as water jet cutting, and plasma cutting. Tool design. Surface Measurement and inspection, telesurf tolerances and specification. Material Selection and design, overview, the selection of materials, service conditions materials and primary processes, Secondary process, welding, machining, thermal treatment, finishing Operations.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Mikell P. Groover, Introduction to Manufacturing Processes, Wiley 2011
- Kalpakjian and Schmid, “ Manufacturing Processes for Engineering Materials” Prentice Hall, 5th Edition 2007
- Creese, R. C., “Introduction to Manufacturing Processes and Materials”, Taylor and Francis, 1999
- Ashby, M. F. and Jones, D. R. H., “Engineering Materials-2”, Pergamon, 2005
- Hwaiyu Geng, “Manufacturing Engineering Handbook”, McGraw-Hill, 2004
- Dieter, G. E., “Mechanical Metallurgy”, McGraw-Hill, 2000
- Paul De Garmo, Mlack, and Kohsar, “Processing Methods in Manufacturing”, Prentice Hall, USA, 2000

Journals/Periodicals
World Wide Web

Title of the Course: **Ferrous Metallurgy**
Credit Hours: 3-0-3
Pre-requisites: -

Specific Objectives of Course: To provide in-depth knowledge of iron and steel making technology.

Course Outline:

Iron ores and Iron bearing minerals. Iron making and its importance. Fluxes and slags, their sources chemistry and uses. Agglomeration and testing of blast furnace burden. Sintering and roasting, blast furnace theory, construction, chemistry and the process. Factors affecting the reducibility and other metallurgical properties of burden. Wrought Iron and sponge Iron. Direct reduction processes of iron making. Steel production, Ingot and continuous casting processes chemistry of steel making, reaction of carbon, oxygen, deoxidation of steel, removal of impurities and killing of steels.. steel making processes including AOD, VOD, ESR, VAR.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Alain Vignes, “Extractive Metallurgy 1: Basic Thermodynamics and Kinetics”, Wiley-ISTE; 1st Edition, 2010.
- Alain Vignes, “Extractive Metallurgy 2: Metallurgical Reaction Processes”, Wiley-ISTE; 1st Edition, 2011.
- Alain Vignes, “Extractive Metallurgy 3: Processing Operations and Routes”, Wiley-ISTE; 1st Edition, 2011.
- Douglas Alan Fisher’ “Steel Making in America”’ United States Steel Corporation’ 2006
- Daniel A. Brandt, J. C. Warner, “Metallurgy Fundamentals: Ferrous and Nonferrous”, 5th Edition, January 2009
- Bradley Stoughton, “Metallurgy of Iron and Steel”, McGraw-Hill, 2006
- Ahindra Ghosh, “Secondary Steel Making”, CRC Press, 2001, ISBN 0849302641
- James McIntyre Camp, Charles Blaine Francis ”The Making Shaping and Treating of Steels” Carnegie-Illinois steel corporation, 2006
- Tretyakov, E., “Iron and Steel Production”, Minerva, 2001.
- Peters, D. “Ferrous Production Metallurgy” Willey

Journals/Periodicals
World Wide Web

Title of the Course: **Non-ferrous Metallurgy**
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To provide students in-depth knowledge of production and refining of materials.

Course Outline:

Introduction to Non Ferrous metals and its ore deposits in Pakistan, Introduction to Non- Ferrous Extractive Metallurgy its scope and importance in Pakistan, Aluminium and its ores, Preparation of Alumina, Preparation of Cryolite, Production of metallic Aluminium, Thermal process of Aluminium, Alloys production, Recovery of other values from Aluminium ores, Aluminium and its alloys, Properties, Microstructure and application. Copper and its ores, Preparation of concentrate, Extraction of Copper ores by pyrometallurgical methods, Matte smelting, Pier Smith converter, Top Blown Rotary Converter, Electrolyte and fire refining of Copper, Recovery of values such as Gold and Silver from Copper ores, Copper and its alloys, Properties and applications. Zinc and Zinc ores, General Preparation of extraction of Zinc, Roasting of Zinc concentrate, Leaching of roasted Zinc concentrate, Electrolysis of Zinc Sulphate solution, Melting of Cathodic Zinc, Production of Zinc retort and blast furnace method, Refining of Zinc, Zinc and its alloys, Properties and application. Lead and its ores, Extraction of lead, Blast roasting of lead concentrate, Blast furnace smelting of lead bullion, Recovery of aluminium and other metals from lead concentrate, Lead and its alloys, Properties microstructure and applications. Magnesium and its ores, Chromium and its ores, Extraction of magnesium and Chromium by Alumino-thermic and silico-thermic method, Refining of Magnesium and Chromium and its alloys, properties microstructure and application. Titanium and its ores, treatment of its ores concentrate, production of titanium metal by reduction with sodium and magnesium. Titanium and its alloys, properties, microstructure and applications. Refining of silicon and other semiconductor materials, Nickel, tungsten, cobalt and alloys. (Contents to be reviewed)

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Mark E. Schlesinger, Matthew J. King, Kathryn C. Sole and William G.I. Davenport, " Extractive Metallurgy of Copper", Fifth Edition , Elsevier, 2011,
- Daniel A. Brandt, J. C. Warner, "Metallurgy Fundamentals: Ferrous and Nonferrous", 5th Edition, January 2009
- Gill, C. B., " Non-Ferrous Extractive Metallurgy", Krieger, 2000
- Polmear, I. J., "Light Alloys", Edward Arnold, 2000
- Balá and Zcaron. P "Extractive Metallurgy of Activated Minerals**"** Elsevier Science, 2000

- Roundhill, Max D., “Extraction of Metals from Soils and Waters**”**, Springer; 1 Springer, 2001

Title of the Course: Design and Selection of Materials
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To provide in-depth knowledge of selection and applications of materials.

Course Outline:

Selection and applications of materials, service conditions, strength-to-density and modulus-to-density ratios, safety and reliability, quality control and quality assurance, prototypes and experimentation, cost analysis (economy) for a component, the lifecycle of materials and components,. Computer applications in materials selection, Material selector, materials data resources (ASM, ASME standards and codes handbook references, websites). Ashby charts.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Michael F. Ashby, “Materials Selection in Mechanical Design, 4th Edition”, Butterworth-Heinemann; 2010.
- Michael F. Ashby, Hugh Shercliff and David Cebon, “Materials 3e North American Edition w/Online Testing: Materials - North American Edition, Second Edition: engineering, science, processing and design, Butterworth-Heinemann; 2nd Edition, 2009.
- Michael F. Ashby, “Materials and the Environment: Eco-informed Material Choice”, Butterworth-Heinemann; 1st Edition, 2009.
- Lawrence W. Fisher, P. E, “Selection of Engineering Materials and Adhesives”, Volume: 186, CRC Press, 2005, ISBN: 9780824740474
- Hummel, Rolf E. “Understanding Materials Science: History, Properties, Applications”, 2nd Edition, Springer, 2005, Joseph Datsko, “Materials Selection for Design and Manufacturing: Theory and Practice”, CRC Press, 1997,
- M. F. Ashby, Kara Johnson, “Materials and Design: The Art and Science of Material Selection in Product Design”, Elsevier Science, 2002, CES 2011 EduPack Software.

Journals/Periodicals
World Wide Web

Title of the Course: **Advanced Materials**
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To provide students thorough understanding of advanced materials.

Course Outline:

Development of new engineering materials, smart materials and functionally gradient materials, biomaterials. Semiconductors, superconductors, optical and magnetic materials. Basic chemical and physical properties of biomaterials, advanced dental materials, including metals, ceramics, and polymers, as they are related to their manipulation by the engineer for incorporation into living systems. Role of microstructure properties in the choice of biomaterials and design of artificial organs, implants, and prostheses. Overview of elevated-temperature characteristics of materials, mechanical properties at elevated temperatures. Processing and properties of super alloys. Directionally solidified and single-crystal super alloys. Microstructural instabilities. Heat-resistant materials, titanium alloys, refractory metals and alloys. Intermetallics, ceramics, carbon-carbon composites. Nanomaterials and their classification. Mechanically alloyed metals, ODS alloys, Nanostructured materials, Fuel cell materials, materials for hydrogen storage. Shape memory alloys, Energy materials, Energetic materials.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Bruce, Dalton, Nelley, Kibbe, Modern Materials and Manufacturing Processes, Prentice Hall 3rd Edition 2003.
- Scott A Guelcher and Hollinger, Jeffrey O., “An Introduction to Biomaterials”, Taylor and Francis, 2005
- Charles P. Poole Jr. and Frank J. Owens, “Introduction to Nanotechnology”, Wiley-Interscience, 2003
- Van de Voorde, M. H. and Meetham, G. W., “Materials for High Temperature Engineering Applications”, Springer, 2000
- Edelstein, A. S. and Cammarata, R. C., “Nanomaterials: Synthesis, Properties and Applications”, IoP, 2001
- Donachie, M. and Donachie, S., “Superalloys: A Technical Guide”, IHS , 2002
- Park, Joon B. and Bronzino, Joseph D., “Biomaterials: Principles and Applications”, Taylor and Francis, 2002
- Nenov, T. G., Yordanov, S. R., “Ceramic Sensors”, Technomic, 1996

Title of the Course: **Welding and Joining Processes**
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To provide knowledge of joining processes of materials.

Course Outline:

Introduction to welding and joining, weld defects, selection of appropriate welding process, effect of heat on metals, pre-heating , stress, strain, weldability , type of joints, types of welds, filler metals, welding problems. Gas welding and equipments. Arc welding, power sources, DC and AC power sources, cables, electrodes, current and circuit polarity, electrode selection, weld deposit. TIG & MIG welding; Introduction, principles, non-consumable tungsten electrodes, gas supply and equipment, and TIG joint preparation, spot welding, electrode wire, gas supply, spray metal transfer method, CO_2 – MIG welding, MIG spot welding. Submerged arc and other shielded methods, equipment, current, flux, electrodes, atomic hydrogen welding, plasma arc welding electro slag welding under water shielded metals, arc welding, vapour shielded metal arc welding- Resistance welding , resistance spot welding, multiple spot welding, flash and upset welding, percussion welding, Thermit welding, equipment and techniques, process, ignition powder removing, the weld inspection, Other welding processes; laser welding, electron beam welding, pressure welding and ultrasonic welding. Soldering, brazing, joining of dissimilar materials, plastic welding, adhesive bonding, bonding materials, inspection and testing of weldments. Riveting and fastening processes.(Some modification required)

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Easterling, K., “Introduction to the Physical Metallurgy of Welding”, Butterworth-Heinemann, 2000
- Lancaster, J. F., “Metallurgy of Welding”, William Andrew, 1999 or latest edition
- Tiku, G. L., “Manual on Joining Processes by Welding, Brazing and Soldering**”** Minerva Press, 2003
- Thomas Böllinghaus and Herold. Horst, “Hot Cracking Phenomena in Welds” Springer; 1st ed., 2005
- Creative Publishing International, “Welding Basics**”** Creative Publishing International, 2003
- Robert W. Messler, “Joining of Materials and Structures: From Pragmatic Process to Enabling Technology”, Butterworth-Heinemann; 1st Edition, 2004.
- Sindo Kou, “Welding Metallurgy”, Wiley-Interscience; 2nd Edition 2002.

- John C. Lippold, Damian J. Kotecki, “Welding Metallurgy and Weldability of Stainless Steels”, Wiley-Interscience; 1st Edition, 2005.
- Jeffus, Roy and Thompson “Welding Principles and Applications” Delmor Cengage 6th Edition 2007.
- Jeffus, Welding: Principles and Applications, Delmor Cengage , 7th Ed. 2011

Journals/Periodicals
World Wide Web

Title of the Course: **Foundry Engineering**
Credit Hours: 3-1-
Pre-requisites:

Specific Objectives of Course: To provide understanding of foundry process of materials.

Course Outline:

Introduction to Foundry Engineering and Practice, Scope and importance of the subject, Simple foundry plant layout, Tooling, equipment, machines and types of furnaces used in foundry, Selection of suitable moulding and core materials, Properties of moulding and core materials, Analysis, testing and control of moulding and core materials requirements.

Types and design of pattern, pattern making, shrinkage and contraction allowances, melting furnaces i.e. pit furnaces, induction melting furnaces, cupola furnaces, Casting of metals and alloys, selection and control of melting processes, control of chemical compositions, casting and fettling operation, metal gas interaction, causes of defects in casting and their remedies, inspection and quality assurance, introduction to new foundry techniques, Mold and component design, Investment casting, Use of Solidcast and Magma for modelling and simulation of solidification behaviour.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- John Campbell, Complete Casting HandbookL Metal Casting Processes, Techniques and Design, Butterworth-Heinemann 2011
- Peter, Beeley “Foundry Technology”, Butterworth-Heinemann; 2nd Edition, 2000
- Chastain Stephen D, **“**Metal Casting,” Chastain Publishing, 2003
- Brooks. Nick, “Mould making and Casting” Crowood Press, 2005
- Campbell. John, “Castings” Butterworth-Heinemann; 2nd Edition, 2003.
- Chastain. Stephen D, “Iron Melting Cupola Furnaces for the Small Foundry” Stephen D. Chastain, 2000

Journals/Periodicals
World Wide Web

Title of the Course: **Corrosion Engineering**
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To impart knowledge of corrosion protection and prevention techniques.

Course Outline:

Corrosion Engineering
Course contents: Introduction and basic definitions, EMF series and Free energy concepts, Electrochemical Cells and their types, Corrosion rate and its units, Uniform corrosion, Atmospheric corrosion, Galvanic corrosion and galvanic series, Crevice corrosion, Pitting, Intergranular corrosion and sensitization, Erosion corrosion and effect of velocity, Cavitation damage, Corrosion fatigue, Fretting, Exfoliation, Hydrogen damage and blistering, Hydrogen embrittlement, Stress corrosion cracking, Passivation, Pourbaix diagrams, Polarization and its types, Exchange current, Evans diagrams and "E-log i" plots, Tafel equations, Corrosion control by design, Inhibitors, their types and protection mechanism, Cathodic protection; theory & practical applications, Anodic protection, Coatings.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Pierre Roberge, Handbook of Corrosion Engineering 2/E, McGraw-Hill Professional 2012
- Revie and Uhlig “Corrosion and Corrosion Control” Wiley 4th Ed. 2008
- Fontana, M. G., “Corrosion Engineering”, McGraw-Hill, 2000
- Einar Bardal, Einar Bargal, “Corrosion and Protection”, Springer, 2004
- Helmut Kaesche, “Corrosion of Metals”, Springer, 2003
- Mansfeld., Florian, “Analytical Methods in Corrosion Science and Engineering”, CRC, 2005
- Jones D.A., “Principles and Prevention of Corrosion”, Macmillan, 1996

Journals/Periodicals
World Wide Web

Title of the Course: **Materials Characterization**
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course:

Course Outline:

Powder diffraction, Debye-Scherrer technique, Laue back/reflection and rotating crystal method, orientation of single crystal, ,. image analysis, electron diffraction, transmission electron microscopy, analytical transmission

electron microscopy, scanning electron microscopy**,** electron micro-probe analysis, XPS, AES, XRF, SPM, AFM, Optical characterization techniques**,** Wet analysis, gas analysis by mass spectrometry, Thermal characterization of materials, TGA, DTA, DSC. Spectroscopic techniques.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Elton N. Kaufmann, Characterization of Materials, 3 Volume Set, Wiley 2012
- Brandon, D. and Kaplan, W. D., "Microstructural Characterisation of Materials", Wiley, 2nd Edition. 2008.
- Wachtman, J. B., "Characterization of Materials, Butterworths-Heinemann, 2000 Loretto, M. H., "Electron Beam Analysis of Materials", 2nd Edition, Chapman and Hall, 1984
- Williams, D. B. and Carter, C. B., "Transmission electron Microscopy", Plenum, 1996
- .Magonov, S. N. and Myung-Hwan Whangbo, "Surface Analysis with STM and AFM. Experimental and Theoretical Aspects of Image Analysis", VCH, 1996
- Goodhew, P.J., Humphreys F.J, "Electron Microscopy and Analysis", 2nd Edition, Taylor & Francis, 1988
- Goldstein, J.I. et. al., "Practical Scanning Electron Microscopy", Plenum, 1975

Journals/Periodicals
World Wide Web

Title of the Course: **Powder Metallurgy**
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To provide understanding of powder metallurgy techniques.

Course Outline:

Commercial methods for production of materials' powder, powder characterization and testing, powder conditioning and function of addition agents. Consolidation of powders, Cold Isostatic Compacting, Hot Isostatic Compacting, Powder Rolling, Powder Forging, Powder Extrusion, Powder Injection Moulding, Spray Forming. Theory of Sintering, Sintering Practice, Sintering Atmospheres, Sintering Furnaces. Powder Metallurgy of Refractory and Reactive Metals, Powder metallurgy of Super Alloys, Dispersion-Strengthened materials, Inserts and carbides. Secondary Operation Performed on P/M parts and products. Inspection and Quality Control for P/M Materials. The Economic of P/M Production.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Anish Upadhyaya, Gopal Shankar Upadhyaya, Powder Metallurgy: Science, Technology, and Materials, Universities Press 2011
- German. Randall, "A - Z of Powder Metallurgy", Elsevier Science, 2006
- West, William G, F. Leander, Pease, "Fundamentals of Powder Metallurgy", Metal Powder Industries Federation 2002
- German, R. M., "Sintering Theory and Practice", Metal Powder Industries Federation, 1996
- Yule, A.J., and Dunkley, J. D., "Atomization of Melts for Powder Production and Spray Deposition" Clarendon Press, 1994
- German, R. M., "Powder Metallurgy Science", Metal Powder Industries Federation, 1984
- Gessinger, G. H., "Powder Metallurgy of Super alloys", Butterworths, 1984

Title of the Course: **Surface Engineering**
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To provide knowledge of surface engineering and coating techniques.

Course Outline:

Basis of Surface engineering, Surface Energy, Thermodynamics of Surfaces, Surface Reconstruction Models, Surface tension, Wetting, Adsorption Models and Surface Area Analysis based on Adsorption, Surface interactions with Ion Beams, Electron Beams and Radiations. Classification of Surface Coatings, Chemical Methods for Surface Coatings, Hard chrome plating, Decorative Chromium plating, Ni Plating, Electroless Ni Plating, Electroless Ni-P-Co coating. Thin magnetic coatings for magnetic applications. Zn plating, Brass plating, Silver Plating, Gold Plating. Hot dip Galvanized coating, Al coating of steel. Oxidation spray coating. Oxidation protective coatings, Phosphate conversion coating. Chromate conversion coatings, aluminum anodizing. Coatings for Mechanical Applications, Thermal Methods for Surface Coatings, High Temperature coatings, high temperature coating systems, Plasma Spraying, Thin Films, PVD, CVD and PECVD techniques, Coating Growth, Coating Characterization and applications, Coatings for wear resistance. Laser treatment of materials, fundamentals and applications. Surface modification and melting by laser treatment.
Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Donald Mattox, Handbook of Physical Vapour Deposition (PVD) Processing, 2nd Edition, William Andrew 2010

- John B Hudson, “Surface Engineering: An Introduction”, Butterworth Heinemann, 2000
- Bose “High Temperature Coatings” Butterworth Heinemann 2007
- Lang E., “Coatings for High Temperature Applications”, Applied Science, 2000
- Heinz Dimigen, “Surface Engineering”, Wiley-VCH, 2000, ISBN 3527301968
- Smith, D. L. “Thin Film Deposition, Principles and Practice”, McGraw-Hill, 2000.
- Grainger, S. and Blunt, J., “Engineering Coatings”, Woodhead, 1998.
- Lang E., “Coatings for High Temperature Applications”, Applied Science, 2000
- Peter Seyffarth , Igor Krytsun, “Laser-Arc Processes and Their Applications in Welding and Material Treatment”, CRC,2002, ISBN-10**:** 041526961X
- J. Mazumder Kluwer, “Laser Processing Surface Treatment and Film Depostion” Academic Publishers, 1996, ISBN 0792339010

Title of the Course: **Advanced Steels**
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To provide thorough understanding of advanced steels.

Course Outline:

Introduction: Microstructure and property relationships in steels, High strength low Alloy (HSLA) steels, micro alloyed steels, stainless steels, duplex steels, high yield steels and super alloys.

Production and Processing: Classifications, production and processing principles, thermomechanical processing, advantages and limitations, TMT steels, dual phase steels, IF (interstitial-free) and ultra-low carbon steels for structural and automotive applications, ultra-low-carbon bainitic steels (ULCB), martensitic steels. Cast irons.

Special Steels: Stainless steels, nitrogen containing fine grained steels, orthopedic steels, superduplex corrosion resistant stainless steels, special steels, TRIP steels, maraging steels, tool steels, die steels, special steels for low to moderate temperature applications for nuclear and thermal power plants, heat resistance steels for superheaters, tool and die steels, processing and properties. Design and processing. Ultra-fine grain refinement in steel.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Honeycombe, R. W. K., “Steels: Microstructure & Properties”, Edward Arnold, London, 2005
- Pickering, F. B., “Physical Metallurgy and Design of Steels”, Applied Science Publishers, 2000.
- Marshall, P., “Austenitic Stainless Steels: Microstructure and Mechanical Properties”, Elsevier Applied Science Publishers, 2000 or latest edition
- Harry Bhadeshia , Robert Honeycombe, “Steels: Microstructure and Properties”, Butterworth-Heinemann; 3rd Edition, 2006.

Journals/Periodicals
World Wide Web

Title of the Course: Fracture Mechanics and Failure Analysis
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To provide thorough understanding of fracture and failure analysis.

Course Outline:

Linear elastic fracture mechanics, Elastoplastic fracture mechanics, Ductile and Brittle fracture, Tensile fracture, Creep and Creep fracture, fatigue and Fatigue fracture, Fracture toughness theory ductile to brittle transition, effect of temperature, Griffith’s theory, micro-voids formation and ductile fracture, cleavage for brittle fracture, cleavage planes, crack opening displacement (COD), stress intensity factor, J integral, elastic-plastic fracture mechanics, , plane stress and plane strain fracture toughness, real time fracture toughness, fracture re-inforcement mechanisms. Fractography, differentiation among different types of fracture surfaces Root cause analysis, Case studies of failed components.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- Hertzberg, “Deformation and fracture mechanics of engineering materials ” 5th Edition, 2012
- Anderson, Ted, Anderson, T. L., “Fracture Mechanics Fundamentals”, 3rd Edition, Taylor & Francis Group, 2005.
- Knott, J. F. and Withey, P., “Fracture Mechanics - Worked examples”, IoM, Latest edition.
- Lancaster, J. F., “Engineering Catastrophes”, Woodhead, 2005
- Gordon W. Powell, “A Fractography Atlas of Casting Alloys”, Battelle, 1992
- ASM International, “Fractography”, Metals Handbook, 12, 9th Edition, ASM International, 1987.

Journals/Periodicals
World Wide Web

Title of the Course: **Furnaces and Energy Conservation**
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To impart knowledge of fuel and furnace used in metallurgical industry.

Course Outline:

Fuels: Classification, preparation, storage, handling, transportation. Combustion of Fuels, low and high temperature carbonisation of coal, liquid fuels, study of petroleum, knock rating. Light and heavy oils., furnace oil. Gaseous fuels, producer gas, water gas, coke oven gas and LPG. Natural gas and its viscosity, calorific intensity, octane number and Cetane number of fuel, analysis of fuel and fuel economy. Furnaces: Types of furnaces, electric, oil, gas, coal. Heat treatment furnaces vacuum furnaces and controlled atmosphere furnaces, grading of furnaces,. Design and construction of furnaces, Power and energy calculations, heat transfer and insulation, temperature measurement procedures and instruments, energy management and cost effectiveness, Design of energy efficient furnaces .

Lab Outline: N/A

Recommended Books:

- Connel “Energy Efficiency “Principles and Practices” Pennwell Corp. 2009
- Gilchrist. J. D., “Fuels”, Edward Arnold, 2000
- Dame and King, “Fuels Technology” Edward Arnold, 2000

Journals/Periodicals
World Wide Web

Title of the Course: **Mineral Processing**
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To provide knowledge of mineral processing.

Course Outline:

Theory of crushing, operation and application of jaw-, gyrator-, cone-, roll, gravity stamp- and special crushers. The theory and application of liberation techniques. Theory and attributes of communication and use of ball, rod and tube mills. Industrial screening, types and operating characteristics screens, the movement of solids in fluids. Stoke’s, Newton-, Rettinger’s Law. Heavy fluid separation, heavy liquids and suspension, principles of jigging. Hydraulic and pneumatic jigs, flowing film concentration and tabling. Flotation and dispersion. Magnetic separation and magnetic properties of substances.

Miscellaneous processes including leaching and separation, heat properties, electrical properties, differential hardness, amalgamation. Separation of solids from fluids by thickening process, filtration, dust elimination and drying. Theory and techniques of concentrates, palletising, nodulizing and briquitting. Flow sheets and circuit diagrams of typical mills treating ores, non-metallic and the solid fuels. Mineral deposits in Pakistan.

Lab Outline: N/A

Recommended Books:

- Wills Barry & Napier-Munn Tim, "Mineral Processing Technology", 7th ed**.,** Butterworth-Heinemann, 2006
- M. C. Fuerstenau, & N. Han, Kenneth "Principles of Mineral Processing". Society for Mining Metallurgy & Exploration, 2003
- Howard L. Hartman, Jan M. Mutmansky, "Introductory Mining Engineering**",** Wiley; 2nd ed., 2002
- A. G. Well, " Mineral Processing".

Journals/Periodicals
World Wide Web

Title of the Course: **BIOMATERIALS**
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To impart knowledge related Biomaterials.

Course Outline:

Introduction and classification, biocompatibility and bioactivity, organic materials processing and synthesis, surfactants, hydroxyapatite (HA) coatings, Total Hip Joint and Knee Joint Replacement implants, materials selection for implants and prostheses, dental materials, enamels, hard and soft tissue regeneration, Transplants, Tribology of human joints Ti alloys and shape memory alloys Bio and Tissue Engineering

Lab Outline: N/A

Recommended Books:

- Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons, Biomaterials Science, 3rd Edition: An Introduction to Materaisl in Medicine, Academic Press, 2012
- Jeffrey O. Hollinger, An Introduction to Biomaterials, 2nd Edition (Biomedical Engineering, CRC Press 2011
- Buddy D. Ratner,2004 Elsevier, "Biomaterials Science"
  Joyce Y. Wong, Joseph D. Bronzino, 2007, CRC Press, "*Biomaterials*"

Jeffrey O. Hollinger, 2011, CRC Press," An Introduction to *Biomaterials*"

- Krishnendu Roy – 2010, Springer, "Biomaterials"
  Lucian A. Lucia, Orlando Rojas – 2009, Wiley.com, "The Nano-science and Technology of Renewable *Biomaterials***"**

Title of the Course: **Nuclear Materials**
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To impart knowledge on nuclear materials.

Course Outline:

Nuclear energy, nuclear reactors, Introduction to nuclear power plant nuclear fission and fusion reactions, neutron absorption cross section, nuclear fuels: uranium, thorium, plutonium; fuel cladding materials: aluminium alloys, stainless steels, zirconium alloys; reflecting materials: graphite, beryllium, moderators, light water, heavy water, graphite; control rod materials: cadmium, boron. Structural materials in nuclear power plants, Materials used in nuclear power plants:. Effect of radiations on properties of materials. : radiation hazards and their safety, health physics. Disposal of radio active wastes.

Lab Outline: N/A

Recommended Books:

- Hemsworth "Nuclear Materials" Nova science PUB inc. 2011
  Materials Science and Technology, Volume 10, Nuclear Materials, Parts I & II, Vol. Editor: Frost, B. R. T, VCH, 1994.
- The American Society of Mechanical Engineers, "Performance and Evaluation of Light Water Reactor Pressure Vessels", 1987

Journals/Periodicals
World Wide Web

Title of the Course: **Vacuum Technology**
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To impart knowledge on vacuum techniques used in the field of materials and metallurgy.

Course Outline:

Vacuum technology: Different units of measuring pressure vacuum regimes, mean free path, collision frequency. Vacuum pumps: Water pumps, positive displacement pumps, rotary and roots pump, vapour ejector and vapour entrainment pumps, diffusion pump, turbo-molecular pump, ion pumps, sieve

pumps, adsorption pumps. Classification and working principles of vacuum measuring devices: Manometers, McLoad gauge, Penning gauge, Pirani gauge. Calculation of vacuum systems, conductance and through put, effective pumping speed, gas flow through pipes and orifices. Sources of leakage, leakage detection and remedies. Application of vacuum in materials processing. Vacuum induction melting, vacuum arc melting. Metal refining in vacuum, degassing in liquid state, vacuum heat treatment, vacuum sintering, vacuum coating, use of vacuum technology in the production of strategic materials. Design of vacuum furnaces.
Vacuum Coatings: Introduction, purpose of vacuum coating, process of vacuum coating, vacuum coating system by electro bio-bombardment beating, valves used in vacuum technology.

Lab Outline: N/A

Recommended Books:

- Alexander Roth, ”Vacuum Technology”, North-Holland, 2007
- Mattox, D. M., “The Foundations of Vacuum Coating Technology”, Noyes Data Corporation/Noyes Publications, 2003
- Choudhury, A, “Vacuum Metallurgy, ASM Intl, 2000
- Inker. O.W, “Vacuum Metallurgy”, Elsevier, 2001
- Alexander Roth, ”Vacuum Technology”, North-Holland, 2007
- Wolfgang Jorisch/ 2010 / John Wiley & Sons Inc, “Vacuum Technology in the Chemical Industry”
- Nagamitsu Yoshimura – /2008/ Springer, “Vacuum technology: practice for scientific instruments”

Journals/Periodicals
World Wide Web

Title of the Course: **Composite Materials**
Credit Hours: 3-1-4
Pre-requisites:

Specific Objectives of Course: To provide knowledge of composite and polymeric materials.

Course Outline:

Introduction to Composite materials, Metal matrix composites MMCs), Polymer matrix composites (PMCs), Ceramic matrix composites (CMCs), classification characteristics, mechanical behaviour potential advantages, properties and applications. Composite material design, specific stiffness and strength, and recent developments such as metal matrix composite, ceramic matrix composites, carbon fibre reinforced composite, Manufacturing and processes for fibres and other reinforcements, polymeric matrix composites, processing principles and design of ply and laminate structures, filament winding and pultrusion.

Recommended Books:

- Ronald F. Gibson, “Principles of Composite Material Mechanics”, 3rd ed, September 2011
- Ever J. Barero, “Introduction to Composite Materials Design”, 2nd ed, July 2010
- Mathew and Rowling ‘Composite Materials’
- Deborah D L Chung, “Composite Materials”, Springer, 2003
- Charles E. Bakis, “Composite Materials”, ASTM International, 2003
- Hull, D. and Clyne, T. W., “Introduction to Composite Materials”, CUP, 1996
- K. K. Chawla “Composite Materials Science and Engineering’ Springer 2001

New course: Polymeric Materials

Survey and classification of polymeric materials. Review of polymer chemistry, introduction to polymers, classification of polymers, polymerisation, co-polymerisation, structure and properties of thermoplastic and thermosetting polymers, elastomers and rubber, vulcanisation, additives and fillers. Manufacturing, properties and applications of polymers, polystyrene, polybutadiene, polyester, polymethyl methylacrylate (PMMA), nylon 6:6, acrylonitrile-butadiene-styrene (ABS), silicon resin, epoxy resin, phenol- formaldehyde and other advanced polymers, forming processes, testing and identification of polymers, fibres, foams and adhesives, Plastics, conductive polymers and plastics.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

- McCrum, N. G. and Buckley, C., “Principles of Polymer Engineering”, OUP, 2002
- Rodriguez, F., “Principles of Polymer Systems”, 5th ed., McGraw-Hill, 2003.
- Rodger, Brendan, “Rubber Compounding: Chemistry and Applications”, Taylor and Francis, 2004
- Margolis J. M. “Conductive Polymers and Plastics”, Chapman & Hall, 1989.
- Mills, N. J., “Plastics: Microstructure, Properties and Applications”, Arnold, 1993
- John W. Nicholson – 2011/ Royal Society of Chemistry “The Chemistry of Polymers”
- Linda C. Sawyer, David T. Grubb, Gregory Frederick Meyers / 2008/ Springer, Polymer microscopy

Title of the Course: **Senior Design Project Part-1**
Credit Hours: 0-9-3
Pre-requisites:

Specific Objectives of Course: To provide students learning of research techniques used in the industry.

Course Outline:

Selected problems from the industry and current materials research issues regarding selection processing, designing, manufacturing and development. Fabrication of prototype/models and laboratory experimentation shall be assigned to individual students/ Grading shall be the reports produced by individual students and their evaluation through an oral examination

Lab Outline: Experimental work will be carried out in the relevant laboratories/industry according to the nature of the project

Recommended Books:

Reference book and journal for latest literature survey and methodology

Title of the Course: **Senior Design Project Part-1I**
Credit Hours: 0-9-3
Pre-requisites:

Specific Objectives of Course: Same as Part-I

Course Outline:

Same as Part-I
Lab Outline: Experimental work will be carried out in the relevant laboratories/industry according to the nature of the project

Recommended Books:

Reference book and journal for latest literature survey and methodology

MANAGEMENT COURSES

ENTREPRENEURSHIP AND MARKETING

Course Objective:

Entrepreneurship is an important component in the process of economic development. The purpose of this course is to analyse the theories of entrepreneurship and to go for case studies of successful entrepreneurs.

Course Contents:

Introduction: The concept of entrepreneurship, the economist view of entrepreneurship, The sociologist view, Behavioural approach, Entrepreneurship and Management

The Practice of Entrepreneurship: The process of entrepreneurship, Entrepreneurial Management, The entrepreneurial business, Entrepreneurship in service institutions, The new venture

Entrepreneurship and Innovation: The innovation concepts, Importance of innovation for entrepreneurship, Sources of innovative opportunities, The innovation process, Risks involved in innovation

Developing Entrepreneur: Entrepreneurial profile, Trait approach to understanding entrepreneurship, Factors influencing entrepreneurship, The environment, Socio cultural factors, Support systems

Entrepreneurship Organization: Team work, Networking organization, Motivation and compensation, Value system

Entrepreneurship and SMES: Defining SMEs, Scope of SMEs, Entrepreneurial, managers of SME, Financial and marketing problems of SMEs

Entrepreneurial Marketing: Framework for developing entrepreneurial marketing, Devising entrepreneurial marketing plan, Entrepreneurial marketing strategies, Product quality and design

Entrepreneurship and Economic Development: Role of entrepreneur in the economic development generation of services, Employment creation and training, Ideas, knowledge and skill development, The Japanese experience

Case Studies of Successful Entrepreneurs

Text Books:

- Paul Burns and Jim Dew Hurst: Small Business and Entrepreneurship
- P.N. Singh: Entrepreneurship for Economic Growth
- Peter F. Drucker: Innovation and Entrepreneurship Peter F. Drucker
- John B. Miner: Entrepreneurial Success

Entrepreneurship and Marketing (3-0-3): Industrial economic strategy, preparation of a business plan for new ventures and financing options for start-up businesses, barrier to entry, corporate governance and megers Information gained through environmental scans on new business opportunities, case studies, sharing the experiences of entrepreneurs and investors, Consulting for or inventing in start-up or entrepreneurial businesses and for professionals.

Recommended Books:

- Michael J Etzel, Bruce J Walker, William J Stanton, Marketing, McGraw-Hill 2010
- William D. Bygrave and Andrew Zacharak, Entrepreneurship 2nd Edition, Wiley, 2012.
- Entrepreneurship by Hisrich, McGraw Hill, 2009
- Principles of Marketing, Cotrell McGraw Hill 2012

MM494 Engineering Management (3-0-3): Industrial networks, fundamentals of product and process development, business community and new generations of managers, practical skills, knowledge and experience in commercialization of new technological inventions, use of multidisciplinary science based knowledge, problem-solving, teamwork, outreach activity, major steps in proof of concept to intellectual property protection, prototype development, fabrication and assembly routes, materials procurement, identification and creation of new markets, development of business plan, appropriate technology and marketing, distribution and financing, routes and strategies for specific technology under development.

Recommended Books:

R. A. Bulgelman, Strategic Management of Technology and innovation, 4th Edition McGraw Hill, 2009.

PRINCIPLES OF MANAGEMENT

Course Objectives:

This is a rudimentary course for the students of business administration. The focus of attention will be given to learning fundamental principles of management and of

managing people and organization in a historical as well as contemporary world. Students are expected to develop analytical and conceptual framework of how people are managed in small, medium and large public and private national and international organizations.

Course Contents:

- Introduction, overview and scope of discipline
- The evolution and emergence of management thought
- Management functions
- Planning concepts, objectives, strategies and policies
- Decision making
- Organizing; departmentalization, line/staff authority, commitments and group decision making
- Staffing: principles of selection, performance, career planning
- Leading: Motivation, leadership, communication
- Controlling: the system and process and techniques of controlling
- Management and Society: future perspective

Text Books:

- Stephen P. Robins, Mary Coulter: Management
- H. Koontz Odonnel and H. Weihrich: Management
- Mc Farland: Management: Foundation and Practice
- Robert M. Fulmer: The New Management.

Nanotechnology (3-0-3): dimensional materials, nanoscale synthesis (bottom-up), production of nanoparticles and clusters, quantum wells and dots, nanowires, nanorods, and nano-multilayered structures, CNTs, self assembly and catalysts, bulk nanomaterials, nanomaterials handling, safety and precautions, special characterization methods for nanomaterials and advanced surfaces, unique physical, chemical and mechanical properties, nano-bio-info-materials, nanodevices, nanotechnology and its prospects for industry.

Recommended Books:

Nanoscale Science and Technology by Kelsall, Hamely & Geoghegan
Wiley (2005)
Introduction to nanotechnology by Poole and Owens, publ: John Wiley, 2003
Handbook of nanotechnology by Bhushan, Springer, 2003

List of Experiments

#	Lab #	Experiment
First Year (1st and 2nd Semester)		
1	I	Identification of Engineering Materials
2	I	Materials for Electronic and Engineering Applications
3	I	Atomic Packing in Crystals
4	I	Crystallography - Work Sheet
5	I	Solidification and Casting of Metals
6	I	Preparation of Metallographic Specimens for Microscopy
7	I	Determination of Young's Modulus of wood and steel.
8	I	Hardness of Engineering Materials
9	I	Impact Tests for Engineering Materials
10	I	Tensile testing of metals.
11	I	Mechanical Properties - Work Sheet
12	I	Creep in Materials
13	I	Oxidation of Metals
14	I	SEM –A Demonstration
15	I	Processing of Ceramics
Second Year (3rd and 4th Semester)		
16	II	International standards for evaluation of the engineering. Materials(exercise/worksheet)
17	II	Tensile test of engineering materials
18	II	Hardness test of engineering materials
19	II	Compression test of metals/alloys
20	II	Notched bar impact test of the engineering materials
21	II	Creep test of the engineering materials
22	II	Torsion test of engineering materials
23	II	Liquid penetrant testing
24	II	Magnetic particle testing -1
25	II	Magnetic particle testing -2
26	II	Ultrasonic testing-1
27	II	Ultrasonic testing-2
28	II	X-ray radiography of the materials
29	III	Specimen Preparation for Metallography (brass, MS, Aluminium)
30	III	Specimen Preparation & Observation of Microstructures (cast iron, quenched, annealed and normalized structures of MS)
31	III	Atomic Packing of Planes and Miller Indices
32	III	Symmetry Contents of Letters, Motifs and common Objects
33	III	Metallography (Quantitative Analysis)
34	III	Stereographic Projections (geometric exercises)
35	III	Introduction to XRD Technique & Equipment * + Rolling Video
36	III	Carburizing (diffusion of carbon into the surface of MS)

37	III	Obtaining Diffraction Pattern from a known Material & Interpretation of Results
38	III	X-Ray Diffractometery & Determination of Crystal Structure
39	III	Structure Factor Calculations for Simple Cubic, FCC, BCC
40	III	Obtaining Diffraction Pattern from a Known Mixture of Two Materials
41	III	Identification of an Unknown Material by X-Ray Powder Diffraction Film
Third Year (5th and 6th Semester)		
42	IV	Size distribution of foundry sand.
43	IV	Annealing, normalizing and quenching and tempering of steel.
44	IV	Identification of polymers using various chemicals and physical methods.
45	IV	Injection moulding of polymers.
46	IV	To study the atomic arrangement, lattice defects and deformation behaviour using a bubble raft model.
47	IV	Testing of moulding sand.
48	IV	Casting by split and single piece patterns.
49	IV	To study the effect of annealing, normalizing and quenching and tempering on tensile properties of mild steel.
50	IV	To study the effect of cooling media on the structure and hardness of steel.
51	IV	Anisotropy in tensile properties of deformed materials.
52	IV	Recovery, recrystallisation and grain growth
53	IV	Tensile test of polymeric materials.
54	IV	Casting of a metal / alloy using centrifugal casting process.
55	IV	To study the effect of strain rate on tensile strength of different polymers.
56	IV	Age hardening behavior of alloys.
57	IV	Strain aging behavior of mild steel.
58	IV	Intercritical heat treatment of mild steel.
59	IV	To study the effect of embrittlement in steel and cast iron by notched bar impact test.
60	IV	Determination of Tg and Tm of polymers.
61	IV	Casting of metals using carbon dioxide-sodium silicate process for mold making.
62	IV	Autempering of steel.
63	IV	Analysis of polymers using Fourier Transformed Infra-red Spectroscopy.
64	IV	Jominy end quench hardenability test.
65	IV	Fatigue test of mild steel.
66	IV	Study of Investment casting process and casting a metal / alloy.
67	V	Casting and Microstructural examination of lead-tin alloys.
68	V	Electrowining of Copper From CuSO solution.
69	V	Cast and Rheocast Aluminum alloys, properties and microstructures

70	V	Cold rolling of Aluminium strips and study of properties and microstructures of cold rolled and annealed samples.
71	V	Hot and cold rolling of copper plate, study of properties and microstructures of rolled plate.
72	V	Introduction to CNC machining
73	V	Demonstration of gas Welding and gas welding of mild steel.
74	V	Gas Welding of Aluminium.
75	V	Soldering and brazing of copper.
76	V	Shielded metal electric arc welding of mild steel, its microstructural examination and properties.
77	V	Welding of stainless steels, study of microstructures and X-ray radiography of the weldments.
78	V	Milling and Characterization of alumina powder.
79	V	Demonstration of high temperature furnace and sintering of alumina compacts
4th Year (7th and 8th Semester)		
80	VI	Part A: Determination of corrosion rate through weight loss method.
81	VI	Part B: Cathodic Protection of Mild Steel using Zinc as Sacrificial Anode
82	VI	Applications of Thermistors and Determination of Temperature – Resistance characteristics of thermistors
83	VI	Hand Lay Up Process of Polymer Matrix Composite Materials
84	VI	Part A: Compiling galvanic series of different metals and alloys using Zero Resistance Ammeter (ZRA).
85	VI	Part B: Measurement of pH of different electrolytes using pH Meter
86	VI	Use of Thermocouples: Comparison of Temperatures in a Tube Furnace with and without Shielding
87	VI	and with Temperatures Indicated by the Controller.
88	VI	3 Point Bend Test of Polymer Matrix Composite Materials
89	VI	Potentiodynamic study of mild steel in 3.5% NaCl solution using Research Potentiostat and Sweep Generator
90	VI	Diodes: Materials Use, Application and Forward Biased and Reverse Biased Characteristics of Silicon and
91	VI	Germanium Diodes
92	VI	Mixing and cold pressing of Aluminium and Aluminium - Silicon Carbide (e.g. Al - SiC) powder.
93	VI	Selective Leaching of Brass and Microstructural Examination
94	VI	Vibrating Sample Magnetometer (VSM) for Magnetic Properties.
95	VI	Part A: Sintering of Aluminium and Aluminium - Silicon Carbide composite Material.
96	VI	Part B: Tensile Testing of Polymer Matrix Composite Materials.
97	VI	Electrochemical studies of mild steel using Gamry Instruments. Measurement of dissolved oxygen using dissolved oxygen (DO) meter
98	VII	Part (A): Examination and Testing of Copper Powder.
99	VII	Part (B): Production of Metallic Powders by Using Different

		Techniques.
100	VII	Part A: Particle Size Analysis of Copper Powder by Using Particle Size Analyser
101	VII	Part B: Liquid Phase Sintering of Copper-Aluminium System.
102	VII	Part A: Effect of different Environments on Sintered Properties of aluminium compacts.
103	VII	Part B: Microstructural Examination of Solid/Liquid Phase copper/copper-aluminium compacts.
104	VII	Production of metallic foam using powder metallurgy methods.
105	VII	Sintering of SiC using high temperature furnace.
106	VII	An Introduction to Automobile Materials.
107	VII	Power Cables: Applications, Types and Material Selection.
108	VII	Materials, components and working of optical fibres
109	VII	Part A: Electric Motors: Working Principle, Types, Different Parts, and Materials used.
110	VII	Part B: Determination of resistance characteristics of thermistors with temperature, its materials and applications.
111	VII	Use of software for application and selection of engineering materials.
112	VII	Measurement of electrical conductivity at low temperatures.
113	VII	Characterization of materials using TGA.
114	VII	Characterization of materials using UV-Vis.
115	VII	Hall effect in P-Germanium
116	VII	Use of Thermocouples: Comparison of Temperatures in a Tube Furnace with and without Shielding
117	VII	Part A: Transistors: Types, parts, materials use and application of transistors
118	VII	Part B: Input and output characteristics of NPN bipolar junction transistor in common emitter configuration.

Graduate Programme

MS Degree Programme in Metallurgy and Materials Engineering

The MS and PhD Programs in Materials Engineering are diverse to cover the wide range of areas of active research and field of specialization such as advanced materials, manufacturing, metallurgical processes, structural properties, new materials, biomaterials and nanomaterials. The criteria and outline of courses are described for adoption as broad guidelines.

MS Degree Programme 4-Semester Duration (02 Years)

Option 1:
Course Work: 24 CH
MS Thesis: 6 CH

Option 2:
MS Course work: 30 CH
Total CH: 30

Core courses are mandatory for MS degree in Materials Engineering

Minimum 3 Core Courses are Requirement:

Course Name	Credit Hours
Materials Thermodynamics	3
Mechanical Behaviour of Materials	3
Phase Transformations	3
Open (depending on the choice of the institute/ department)	3

Elective Courses:

Elective Requirement (4)

Minimum Four (4) Courses can be selected from the listed given below:

Course Title	Credit Hours	Course Title	Credit Hours
Theory of Dislocations	3	Advanced Coating technology	3
Fracture mechanics and Failure Analysis	3	Surface analysis and characterization	3
Metal Forming	3	Tribology Engineering	3
Thermo-mechanical Processing	3	Thin Film Technology	3
Micro structural Control	3	Carbon Materials	3
Advanced Manufacturing Systems	3	Polymer Science and Engineering	3
Advanced Joining Technology	3	Advance Ceramics Engineering	3
Nanomaterials	3	Electronic Materials	3

Smart Materials	3	Magnetic Materials	3
Nanotechnology	3	Optical Materials	3
Synthesis and Design of Nano structures and Devices	3	Advanced Composite Materials	3
Advances in Extractive Metallurgy	3	Nanomaterials and Computer Aided Nano-design	3
Solidification	3	Electron Microscopy	3
Advance Characterization Techniques	3	X-Ray Diffraction and Texture Studies32 Modelling of Material Processing	3
Modern Steels and Processes	3	Powder Metallurgy	3
Biomaterials	3	Computational Materials Engineering	3
Corrosion monitoring and prevention	3	Mathematical Methods in Engineering/Computational Methods for Engineers	3
Surface Science and Engineering	3	Industrial Management	3

Interfaculty Electives:

- Student may have option to register one Interfaculty course.

PhD Degree Programme in Metallurgy and Materials Engineering

PhD Degree Programme (Minimum 3 Years)

Total number of credits	30
Course work credits	18
Dissertation	12

RECOMMENDATIONS

After thorough deliberations the committee proposed the following recommendations:

The committee is of the view that the field of metallurgy and materials engineering can contribute in the national development and support the industry and R&D institutions.

1. The Universities should be facilitated to impart quality education and produce engineers who are capable to undertake research and industrial assignments and pursue higher studies.

2. The curriculum designed should guide the universities and relevant departments offering this program to meet the minimum benchmark for the Bachelor degree programme in Metallurgy and Materials Engineering. The study program should have 65-70% engineering courses and 30-35% of non-engineering courses, the curriculum should be revised after every three years.

3. HEC should review the functional English language courses to include technical report writing, thesis and communication skills.

4. Universities should have plan for providing opportunities to students for preferable internship programme and offer final year projects also relevant to industrial needs.

5. HEC must facilitate local printing of low priced editions of internationally acclaimed text books recommended for the programme, availability of lab equipment and Software relevant to the field of metallurgy and materials engineering.

6. HEC should support and encourage utilization of facilities located at various universities across the country.

7. HEC should arrange resources for video-conferencing and lectures sharing amongst the departments offering this programme.

8. All the universities/institutions offering this programme must focus on developing industrial linkages and international collaborations with foreign universities.

HEC should review the faculty development programme to allocate more funding to increase scholarships in this field of metallurgy and materials engineering.

Annex "A"

COMPULSORY COURSES IN ENGLISH FOR BE/BSc IN ENGINEERING DISCIPLINE

Semester – I

Functional English

Objectives: To enhance language skills and develop critical thinking

Course Contents

Basics of Grammar
Parts of speech and use of articles
Sentence structure, Active and passive voice
Practice in unified sentence
Analysis of phrase, clause and sentence structure
Transitive and intransitive verbs
Punctuation and spelling

Comprehension

Answers to questions on a given text

Discussion

General topics and every day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

Listening

To be improved by showing documentaries/films carefully selected by subject teachers)

Translation skills

Urdu to English

Paragraph writing

Topics to be chosen at the discretion of the teacher

Presentation skills

Introduction

Note: Extensive reading is required for vocabulary building

Recommended Books:

1. Functional English

a) Grammar

1. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 1. 3rd Edition. Oxford University Press. 1997. ISBN 0194313492

2. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 2. 3rd Edition. Oxford University Press. 1997. ISBN 0194313506

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.

c) Reading/Comprehension

1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

d) Speaking

Semester II

Communication Skills

Objectives: To enable the students to meet their real life communication needs

Course Contents:

Paragraph writing
Practice in writing a good, unified and coherent paragraph

Essay writing
Introduction

CV and job application

Translation skills
Urdu to English

Study skills
Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

Academic skills
Letter / memo writing and minutes of the meeting, use of library and internet recourses

Presentation skills
Personality development (emphasis on content, style and pronunciation)

Note: documentaries to be shown for discussion and review

Recommended books:
Communication Skills

a) Grammar

1. Practical English Grammar by A. J. Thomson and A.V. Martinet. Exercises 2. 3rd Edition. Oxford University Press 1986. ISBN 0 19 431350 6.

b) Writing

1. Writing. Intermediate by Marie-Chrisitine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

c) Reading

1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
2. Reading and Study Skills by John Langan
3. Study Skills by Riachard Yorky.

Semester III

Technical Writing and Presentation Skills

Objectives: To enhance language skills and develop critical thinking

Course Contents:

Presentation skills

Essay writing
Descriptive, narrative, discursive, argumentative

Academic writing
How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

Technical Report writing

Progress report writing

Note: Extensive reading is required for vocabulary building

Recommended books:
Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing
   1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).

   2. College Writing Skills by John Langan. McGraw-Hill Higher Education. 2004.
   3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

b) Presentation Skills
c) Reading
   The Mercury Reader. A Custom Publication. Compiled by norther Illinois University. General Editiors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

Semester III

Technical Writing and Presentation Skills

Objectives: To enhance language skills and develop critical thinking

Course Contents:

Presentation skills

Essay writing
Descriptive, narrative, discursive, argumentative

Academic writing
How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

Technical Report writing

Progress report writing

Note: Extensive reading is required for vocabulary building

Recommended Books:
Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing

1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).

4. College Writing Skills by John Langan. McGraw-Hill Higher Education. 2004.
5. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

d) Presentation Skills

e) Reading

The Mercury Reader. A Custom Publication. Compiled by norther Illinois University. General Editiors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

Annex-B

ISLAMIC STUDIES (Compulsory)

COURSE PROFILE

S.NO	TITLES	DETAIL
1	**Name of Course**	**Islamic Studies(Compulsory)**
2	**No. of Credit Hours**	**2 Credit Hours**
3	**Nature of Course**	**Compulsory at Graduation Level**
4	**Total Teaching Weeks**	**18**
5	**Objectives of the Course**	This course is aimed at: 1-To provide Basic information about Islamic Studies 2-To enhance understanding of the students regarding Islamic Civilization 3-To improve Students skill to perform prayers and other worships 4-To enhance the skill of the students for understanding of issues related to faith and religious life
6	**Components of Teaching of the Course**	

LEVEL OF COURSE	GRADUATION
NAME OF DEGREE	BS
NAM OF COURSE	ISLAMIC STUDIES
SEMESTER	AS PER REQUIREMENT OF THE UNIVERSITY
NO. OF CREDIT	2
TOTAL TEACHING HOURS	AS PER HEC REQUIRMENTS
NO. OF PERIODS PER WEEK	2
TOTAL TEACHING PERIOD OF COURSE	18 WEEKS

UNIT NO.1: **INTRODUCTION TO QURANIC STUDIES**

1) Basic Concepts of Quran
2) History of Quran
3) Uloom-ul -Quran

UNIT No.2: STUDY OF SELLECTED TEXT OF HOLLY QURAN

1) Verses of Surah Al-Baqara Related to Faith (Verse No-284-286)
2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi

(Verse No-1-18)

3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
5) Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

UNIT No.3: STUDY OF SELLECTED TEXT OF HOLLY QURAN

1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6, 21, 40, 56, 57, 58.)
2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
3) Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

UNIT NO.4: SEERAT OF HOLY PROPHET (S.A.W) I

1) Life of Muhammad Bin Abdullah (Before Prophet Hood)
2) Life of Holy Prophet (S.A.W) in Makkah
3) Important Lessons Derived from the life of Holy Prophet in Makkah

UNIT NO.5: SEERAT OF HOLY PROPHET (S.A.W) II

1) Life of Holy Prophet (S.A.W) in Madina
2) Important Events of Life Holy Prophet in Madina
3) Important Lessons Derived from the life of Holy Prophet in Madina

UNIT NO.6: INTRODUCTION TO SUNNAH

1) Basic Concepts of Hadith
2) History of Hadith
3) Kinds of Hadith
4) Uloom –ul-Hadith
5) Sunnah & Hadith
6) Legal Position of Sunnah

UNIT NO.7 SELLECTED STUDY FROM TEXT OF HADITH

UNIT NO.8 INTRODUCTION TO ISLAMIC LAW & JURISPRUDENCE

1) Basic Concepts of Islamic Law & Jurisprudence
2) History & Importance of Islamic Law & Jurisprudence
3) Sources of Islamic Law & Jurisprudence
4) Nature of Differences in Islamic Law
5) Islam and Sectarianism

UNIT NO.9: ISLAMIC CULTURE & CIVILIZATION

1) Basic Concepts of Islamic Culture & Civilization
2) Historical Development of Islamic Culture & Civilization

3) Characteristics of Islamic Culture & Civilization
4) Islamic Culture & Civilization and Contemporary Issues

UNIT NO.10: **ISLAM & SCIENCE**

1) Basic Concepts of Islam & Science
2) Contributions of Muslims in the Development of Science
3) Quran & Science

UNIT NO.11:ISLAMIC ECONOMIC SYSTEM

1) Basic Concepts of Islamic Economic System
2) Means of Distribution of wealth in Islamic Economics
3) Islamic Concept of Riba
4) Islamic Ways of Trade & Commerce

UNIT NO.12: **POLITICAL SYSTEM OF ISLAM**

1) Basic Concepts of Islamic Political System
2) Islamic Concept of Sovereignty
3) Basic Institutions of Govt. in Islam

UNIT NO.13: **ISLAMIC HISTORY**

1) Period of Khlaft-e-Rashida
2) Period of Ummayyads
3) Period of Abbasids

UNITNO.14 : SOCIAL SYSTEM OF ISLAM

1) Basic Concepts of Social System of Islam
2) Elements of Family
3) Ethical Values of Islam

REFERENCE BOOKS:

1) Hameed Ullah Muhammad, "E**mergence of Islam**" , Iri, Islamabad
2) Hameed Ullah Muhammad, "M**uslim Conduct of State**"
3) Hameed Ullah Muhammad, 'I**ntroduction to Islam**
4) Mulana Muhammad Yousaf Islahi,"
5) Hussain Hamid Hassan, **"An Introduction to the Study of Islamic Law"** leaf Publication Islamabad, Pakistan.
6) Ahmad Hasan, **"Principles of Islamic Jurisprudence"** Islamic Research Institute, international Islamic University, Islamabad (1993)
7) Mir Waliullah, **"Muslim Jurisprudence and the Quranic Law of Crimes"** Islamic Book Service (1982)
8) H. S. Bhatia, **"Studies in Islamic Law, Religion and Society"** Deep & Deep Publications New Delhi (1989)
9) Dr. Muhammad Zia-ul-Haq, **"Introduction to Al Sharia Al Islamia"** Allama Iqbal Open University, Islamabad (2001)

Annex "C"

Pakistan Studies (Compulsory)

(As Compulsory Subject for Degree Students)

Introduction / Objectives:

The course has been designed as a compulsory subject for the students studying for Bachelor's degree, general or professional. The course is of 3 credit hours carrying 100 marks (recommended). The teaching work is comprised of three dimensions: Historical Perspective (20%); Government and Politics (40%); and Contemporary Pakistan (40%).

The course framework is issue-oriented. It has many dimensions, the historical and ideological background of Pakistan the process of governance and national development as well as the issues arising in the modern, age and posing challenges to Pakistan. The course has been designed with a vision that Pakistan Studies should open a window to future.

Course Outline:

1. **Historical Perspective**
   a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
   b. Factors leading to Muslim separatism
   c. People and Land
      i. Indus Civilization
      ii. Muslim advent
      iii. Location and Geo-Physical features.

2. **Government and Politics in Pakistan**
   Political and constitutional phases:
   a. 1947-58
   b. 1958-71
   c. 1971-77
   d. 1977-88
   e. 1988-99
   f. 1999 onward

3. **Contemporary Pakistan**
   a. Economic institutions and issues
   b. Society and social structure
   c. Ethnicity
   d. Foreign policy of Pakistan and challenges
   e. Futuristic outlook of Pakistan

Recommended Books:

1. Burki, Shahid Javed. State & Society in Pakistan, the Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. Issue in Pakistan's Economy. Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. Pakistan's Foreign policy: An Historical analysis. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. Pakistan Political Roots & Development. Lahore, 1994.
5. Wilcox, Wayne.The Emergence of Bangladesh, Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. Pakistan Kayyun Toota, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. Ethno - National Movement in Pakistan, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. Enigma of Political Development. Kent England: WmDawson & sons Ltd, 1980.
9. Zahid, Ansar. History & Culture of Sindh. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. Political Parties in Pakistan, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. The Political System of Pakistan. Boston: Houghton Mifflin, 1967.
12. Aziz, K. K. Party, Politics in Pakistan, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, Pakistan under Martial Law, Lahore: Vanguard, 1987.
14. Haq, Noor ul. Making of Pakistan: The Military Perspective. Islamabad: National Commission on Historical and Cultural Research, 1993.

Annex "D"

COURSES FOR SOCIAL SCIENCE

Sociology and Development

(For Engineers)

Objectives: The main objective of this course is to apprise potential engineers about social factors that contribute towards enhancing their professional performance for the good of society and the country. This course is culture specific and has to be taught within the context of local and national socio-economic environment. The engineers are expected to supervise several people in different capacities and their understanding about human behaviour is critical for their optimum performance. Modification of human behaviour or getting work done from sub-ordinates and seniors remain a major challenge for all the professional engineers. This course will enhance understanding about the determinants of human behaviour, which ultimately will result in improved individual efficiency.

1. Introduction to Sociology

- 1.1 What is sociology?
- 1.2 Nature, Scope, and Importance of Sociology
- 1.3 Social Interactions
- 1.4 Social Groups
- 1.5 Social Institutions

2. Culture and Related Concepts

- 2.1 Definition of Culture
- 2.2 Types of Culture
- 2.3 Elements of Culture
- 2.4 Role of Culture in Organization
- 2.5 Socialization and Personality

3. Interpersonal Relations

- 3.1 Interpersonal Behaviour
- 3.2 Formation of Personal Attitudes
- 3.3 Language and Communication
- 3.4 Motivations and Emotions
- 3.5 Public Opinion

4. Social Stratification

- 4.1 Factors of Social Stratification
- 4.2 Caste and class
- 4.3 Power, Prestige, and Authority
- 4.4 Social Mobility
- 4.5 Migration

5. Human Ecology

5.1 Ecological Processes
5.2 Ecosystem and energy
5.3 Ecosystem and Physical Environment
5.4 Solid Waste Disposal
5.5 Pollution

6. Population Dynamics

6.1 World Population Growth and Distribution
6.2 Population Dynamics in Pakistan
6.3 Causes and Consequences of Urbanization
6.4 Population Policy in Pakistan
6.5 Population and Development

7. Community Development

7.1 Meaning, Scope, and Subject Matter of Community Development
7.2 Processes of Community Development
7.3 Community Development Programs in Pakistan
7.4 Community Organization and Related Services
7.5 Cooperation and Conflict in Community Development

8. Deviance and Crime

8.1 Crime as a Social and Cultural Phenomenon
8.2 Crime and Social Organization
8.3 Organized Crime
8.4 Culture Based Crime
8.5 Economics of Crime

9. Sociology of Change and Development

9.1 What is Social Change and Development?
9.2 Dynamics of Social Change
9.3 Role of NGOs in Development
9.4 World System and Development
9.5 Gender and Development

Recommended Readings

1. Allport, G. W. (1985). The Historical Background of Modern Social Psychology. New York, Random House.
2. Bernard, A. and T. Burgess (2004). Sociology, Cambridge University Press.
3. DuBrin, A. J. (2007). Human Relations: Interpersonal Job Oriented Skills. New York, Prentice Hall.
4. Gardezi, H. N., Ed. (1991). Understanding Pakistan: The Colonial Factor in Societal Development. Lahore, Maktaba Fikr-o-Danish.
5. Hafeez, S. (1991). Changing Pakistan Society. Karachi, Royal Book Company. Gardezi, H. N., Ed. (1991).

6. Jones, G. W. (2005). "Why are Population and Development Issues not Given Priority?" Asia-Pacific Population Journal **20** (1).
7. Macionis, J. J. (1999). Sociology 7th Edition, National Book Foundation, Islamabad
8. Maser, C. (1997). Sustainable Community Development: Principles and Concepts. Plorida St. Lucie Press.
9. Nelson, N. and S. Wright (1995). Power and Participatory Development: Theory and Practice. London, Intermediate Technology Publications.
10. Syed, S. H. (2003). The State of Migration and Multiculturalism in Pakistan: The Need for Policy and Strategy. Islamabad, UNESCO**:** 1-30.
11. Utton, A. E. (1976). Human Ecology, West View Press.
12. Webster, A. (1990). Introduction to Sociology of Development. London, Macmillan Education Ltd.
13. Weiss, A. M. (2001). Power and civil society in Pakistan, Oxford University Press.

SOCIAL ANTHROPOLOGY

(For Engineers)

Objectives: The students are expected to learn anthropological skills for application by professional engineers and other related practitioners. Societal growth needs are to be understood within our own cultural environment. Such a body of applied knowledge will result in improving the professional performance of would-be engineers. As culture and society play an important role towards all human activities, this course will help students relate technical skills to the societal needs and requirements.

I Introduction

1. Anthropology and Social Anthropology
2. Fields of Anthropology
3. Anthropological Research Methods
4. Social Anthropology and other Social Sciences
5. Significance of Social Anthropology

II Culture

1. Definition, Properties and Taxonomy
2. Evolution of Growth and Culture
3. Evolution of Man: Religious and Modern Perspectives
4. Evolution of Culture
5. Culture and Personality

III Evolution and Growth of Culture

1. Evolution of Man
2. Schools of Thought in Cultural Anthropology
3. Acculturation
4. Enculturation

5. Ethnocentrism and Xenocentrism

IV Language and Culture

1. Communication
2. Structural Linguistics
3. Historical Linguistics
4. Relationship between Language and Culture
5. Ethnography

V Economic System

1. Global Economic System
2. The Allocation of Resources
3. The Conversion of Resources
4. The Distribution of Goods and Services
5. Poverty and Inequality

VII Marriage and Family

1. Marriage and Mate Selection
2. The Family: Types and Functions
3. Kinship System
4. Structure and Function of Family
5. Gender Relations

VIII Political Organization

1. Political Sociology
2. Origin of Political Organization and Organizational System
3. Types of Political Organizations
4. Power Politics and Factionalism in Pakistan
5. Resolution of Conflict

IX Religion and Magic

1. The Universality of Religion
2. Comparative Religions
3. Religion and Society
4. Religious Beliefs and Practices
5. Witchcraft and Sorcery

XI Culture Change

1. Forms of Art
2. Expressive Culture
3. Process of Cultural Change
4. Cultural Change in the Modern World
5. Cultural Change in Pakistani society

Recommended Books:

1. Ahmad, Akbar S. 1990. Pakistani Society, Karachi, Royal Books Co.

2. Bernard, H. Russel. 1994. Research Methods in Anthropology, Qualitative and Quantitative Approaches. London: Sage Publications
3. Bodley, John H. 1994. Cultural Anthropology, California: Mayfield Publishing Co.
4. Brogger, Jan. 1993. Social Anthropology and the Lonely Crowd. New Delhi: Reliance Publishing
5. Ember, Carol R. & Ember Melvin. 2005. Anthropology, 11th ed. Englewood Cliffs: Prentice Hall, Ince. Harper and Row
6. Harris Marvin. 1987. Cultural Anthropology. New York: Harper and Row
7. Harris Marvin. 1985. Culture, People, nature; An Introduction to General Anthropology London: Harper and Row
8. Haviland, W. A. (2005). Anthropology: The Human Challenge. New York, Thomson Learning Inc.
9. Hertzler J. O. 1981. The Social Structure of Islam. Cambridge: Cambridge University Press.
10. Keesing, Roger m. 1998. Cultural Anthropology: A contemporary perspective. 3rd ed. New York: Harcourt Brace College Publishers.
11. Kottak, Conard Phillip. 2002. Anthropology: The Exploration of Human Diversity. 9th ed. Boston: McGraw-Hill Higher Education.
12. Kennedy, Charles H. 1992. Pakistan London: Westview Press,.
13. Marron, Stanley. 1057. Pakistani Society and Culture. New Heaven
14. Wilson, Richard A. 1996. Human Rights, Culture and Context: Anthropological Perspective. London: Pluto Press.

Psychology courses for BSc/B.E in Engineering Programme

Course-I **Understanding Psychology and Human Behaviour** 3 credit hrs

- What is Psychology?
- Nature, Scope and Application with Special Reference to Pakistan
- Different Schools of Psychology
- Methods of Psychology
- Learning
- Intelligence and Artificial Intelligence
- Personality and its Assessment
- Understanding Maladjustive Behaviour
- Positive Emotional States and Processes
- Stress Management and Anger Management

Recommended Books:

1. Atkinson R. C., & Smith E. E. (2000), Introduction to Psychology (13th ed.), Harcourt Brace College Publishers.

2. Fernald, L. D., & Fernald, P. S. (2005), Introduction to Psychology, USA: WMC Brown Publishers.
3. Hergenhahn, B. R. (2001). An Introduction to the History of Psychology, New York: Wadsworth.
4. Goodwin, C. J, (2000) Research in Psychology: Methods and Design, (3rd ed.), New York: John Wiley & Sons.
5. Synder, C. R., & Lopez, S. J. (2007) Positive Psychology, USA, Sage Publications.
6. Allen, B. P. (1997), Personality Theories: Development, Growth and Diversity, (2nd Ed.), Boston: Allyn & Bacon.
7. Cohen, R. J., & Swerdlik, M. E. (2005) Psychological Testing & Assessment (6th ed.), New York: McGraw-Hill.
8. Corcini, R., (2000). Current Psychotherapies. London: Thompson & Co Publishers.
9. Comer, R. J. (2004). Abnormal Psychology, USA: Freeman & Company.
10. Schwartz, B., Wassernman, E., & Robbins, S. (2002), Psychology of Learning and Behaviour, 5th Ed. Norton and Company.

Course II **Professional Psychology** 3 credit hrs

- Introduction to Professional Psychology
- Psychological Testing
- Educational Psychology
- Industrial/Organizational Psychology
- Social Psychology
- Health Psychology
- Clinical Psychology
- Positive Psychology
- Legal, Ethical, and Professional Issues.

Books Recommended:

1. Crow, L., & Crow, A. (2000) Educational Psychology, New Delhi: Eurosia Publishing House Ltd.
2. Spiegel, P. K., & Koocher, G. P. (1998), Ethics in Psychology, New York: Oxford University Press
3. Snyder, C. R., & Lopes, S. J. (2000), Handbook of Positive Psychology, New York: Oxford University Press.
4. Compton, W. C. (2005), Introduction to Positive Psychology, USA, Thomson Wadsworth.
5. Debra, L. N. & James Compbell Quick, (2000) Organizational Behaviour (3rd ed), Cincinnat: South Western.
6. Fred Luthans, Alexander, D.S. & Edwin, A. Locke (2000) (Eds), Handbook of Principles of Organizational Behaviour, London: Blackwell.
7. Brannon, L. & Reist, J. (2000), Health Psychology: An Introduction to Behaviour and Health (4th ed.), USA Wadsworth.

8. Donohue, W. & Ferguson, K. (Eds), (2003), Handbook of Professional Ethics for Psychologists; Issues, Questions and Controversies, London: Sage Publications.
9. Meyers, D. (2005), Social Psychology, 8th Ed. McGraw Hill Inc.
10. Cooper, J. & Hogg, M. (2003) Handbook of Social Psychology, Sage Publications
11. Halgin, R. P., Whitbourne, S. K., & Halgin, R. (2004), Abnormal Psychology: Clinical Perspectives on Psychological Disorders, New York: McGraw-Hill.
12. Thorndike R. L., & Hage, E. P. (1995), Measurement and Evaluation in Psychology and Education (4th Ed), New York, MacMillan.

PROFESSIONAL ETHICS

Course Description:

Prerequisite: None

Co-requisite: None

This course introduce contemporary and controversial ethical issues facing the business community. Topics include moral reasoning, moral dilemmas, law and morality, equity, justice and fairness, ethical standards, and moral development. Upon completion, students should be able to demonstrate an understanding of their moral responsibilities and obligations as members of the workforce and society.

Course Objectives:

At the completion of the course requirements, the student will be able to:

a. Define business ethics
b. Describe the evolution of business ethics
c. Describe major ethical perspectives
d. Understand and apply n ethical decision-making framework
e. Understand social responsibility from several dilemensions
f. Understand how the organization influences ethical decision-making
g. Examine how significant others influence ethical decision-making
h. Develop an effective ethics programme.
i. Understand international business ethics.

Course Outline:

An Overview of Business Ethics: Business Ethics Defined, Social Responsibility, and Business Ethics, The Development of Business Ethics, Why study Business Ethics?, Framework for Studying Business Ethics.

Ethical issues in Business: Foundation of Ethical Conflict, Classifications of Ethical, Issues, Ethical Issues Related to Participants and Functional Areas of Business, Recognizing an Ethical Issue.

Applying Moral Philosophies to Business Ethics: Moral Philosophy Defined, Moral Philosophy Perspectives.

Social Responsibility: The Economic Dimension, The legal Dimension, The Ethical Dimension, the Philanthropic Dimension.

An Ethical Decision-Making Framework: Ethical Issue Intensity, Individual Factors: Stages of Cognitive Moral Development, Corporate Culture, Significant others, Opportunity, Business Ethics Evaluations and Intentions, Using the Ethical Decision-Making Framework to Improve Ethical Decisions.

How the Organization Influences Ethical Decision Making: Organizational Structure and Business Ethics, the role of Corporate Culture in Ethical Decision-Making, Group Dimensions of Organizational Structure and Culture, Implications of Organizational Relationships for Ethical Decisions.

The Role of Opportunity and Conflict: Opportunity, Conflict.

Development of an Effective Ethics Programme: An Effective Ethical Compliance, Programme, Codes of Ethics and Compliance Standards, High-Level Manager's Responsibility for Ethical Compliance Programme and the Delegation of Authority, Effective Communication of Ethical Standards, Establishing Systems to Monitor, Audit, and Enforce Ethical Standards, Continuous Improvement of the Ethical Compliance Programme, The Influence of Personal Values in Business Ethics Programmes, The Ethical Compliance Audit.

International Business Ethics: Ethical Perceptions and International Business, Culture As a Factor in Business, Adapting Ethical Systems to a Global Framework: Cultural Relativism, the Multinational Corporation, A universal Set of Ethics, Ethical Issues Around the Globe.

Text Books:

- Ferrell, O.C., and Fraedrich, John, Ethical Decision Making and Cases, New York: Houghton Mifflin.

ORGANIZATIONAL BEHAVIOUR **3 Credit Hrs**

- Introduction to Organizational Behaviour
  - Organizational Disciplines and topics
  - Psychological Perspective
  - Social-Psychological Perspectives

- Structure and Control in Organization
  - Introduction
  - Bureaucracy
  - Managerial Work
  - Contingency theory
  - Organizational Design

- Individual and Work Learning
  - Learning Theories
  - Learning and Work

- Stress
  - Types of Stress and Work
  - Occupational Stress Management

- Individual Differences
  - Personality and its factors
  - Personality dimensions and social learning
  - Intelligence

- Motivation and Job Satisfaction
  - Needs at Work
  - Theories of Motivation and job satisfaction
  - Correlates of Job satisfaction
  - Correlates of Job satisfaction

- Group and Work
  - Social Interaction
  - Dramaturgy and impression Management
  - Social Skill

- Group and Inter group Behaviour
  - Group Structure & Norms
  - Group Processes
  - How throne Studies

- Leadership
  - Leadership as an attribute
  - Leadership Style

- Patterns of Work
  - Work-the classical approach
  - Marx, Weber, & The critique of labor
  - Foucault & Disciplinary Power

- Conflict and Consent in Work
  - The labor Process debate
  - Work place control and resistance
  - Industrial conflict and industrial relations

- Organizational culture
  - Organizational culture and strategic management
  - Exploring organizational culture
  - Evaluating concept of culture

Recommended Books

1. Finchan, R., & Rhodes, P. (2003), Principles of Organizational Behaviour, 3rd Oxford.
2. Noe, R., Hollenbeck, J. Gerhart, B., & Wright, P. (2006), Human Resource Management, 5th ed., McGraw Hill.
3. Newstrom John W. (2007), Organizational Behaviour, (12th Ed), McGraw Hill.
4. Luthan Fred, (2005), Organizational Behaviour, McGraw Hill Inc.
5. Robins, Stephen, (2005), Organizational Behaviour, McGraw Hill Inc.

INTRODUCTION TO SOCIOLOGY 3 Credit Hrs

- The Nature of Sociology
  - The study of social life
  - Exploring the global village
  - Sociology as a science
  - The Sociological imagination
  - The development of Sociology
  - Pioneers of Sociology
  - Nature, scope and subject matter of Sociology
  - Brief historical development of Sociology
  - Society and community
  - Relationship with other social sciences
  - Social Interaction Processes

- Social groups
  - Definition and functions
  - Types of social groups

- Social institutions
  - Definition
  - Structure and function of social institutions
  - Inter-relationships among various social institutions

- Culture and related concepts
  - Definition and aspects of culture
  - Elements of culture
  - Organization of culture
  - Other concepts, cultural relativism, sub cultures, ethnocentrism, culture lag

- Socialization and personality
  - Role and status
  - Socialization
  - Culture and personality

- Deviance and social control
  - Definition and types of deviance
  - Juvenile delinquency
  - Formal and information methods of social control

- Social stratification
  - Approach to study social stratification
  - Caste class and race as basics of social stratification

- Major perspectives in Sociology
  - Functionalist perspective
  - Conflict perspective
  - Interactionstic perspective

- Social Control and deviance
  - Agencies of social control

- Social stratification
  - Determinants of social stratification
  - Social mobility, types and definition
  - Dynamics of social mobility

- Concept of social movement
  - Theories of social movement
  - Social and cultural change

- Social and cultural change
  - Definition of social change
  - Dynamics of social change
  - Impact of globalization on society and culture
  - Resistance to change

- Collective behaviour
  - Definition
  - Characteristics

- Causes
- Types
- Social movements
- Mob and crowd behaviour

Books Recommended:

1. Neulreck, Kenneth, J. 2005, Sociology: Diversity, Conflict and Change, Boston
2. Barnard, Andy. 2004. Sociology, Cambridge University Press
3. Giddens, Anthony, 2004, Sociology 4th edition, Cambridge Polity Press
4. Albrow, Martin, 2003, Sociology, London Routledge.
5. Richard, T. Schaefer, 2003, Sociology5th edition, McGraw Hill College
6. Kendall, Diana, 2004. Sociology in our Times, 4th ed, Wadsworth
7. Tyler Melissa, Wallace Claire & Abbott Pamela, 2005, An Introduction to Sociology, 3rd ed. Routledge.

CRITICAL THINKING 3 Credit Hrs

- The Power of Critical Thinking
  - Claims and Reasons
  - Reasons and Arguments
  - Arguments in the Rough
- The Environment of Critical Thinking
  - Perils of Haunted Mind
  - Self and the Power of the Group
  - Subjective and Social Relativism
  - Skepticism

- Making Sense of Arguments
  - Arguments Basics
  - Patterns
  - Diagramming Arguments
  - Assessing Long Arguments

- Reasons for Belief and Doubt
  - Conflict Experts and Evidence
  - Personal Experience
  - Fooling Ourselves
  - Claims in the News

- Faulty Reasoning
  - Irrelevant Premises
  - Genetic Fallacy, Composition, Division
  - Appeal to the Person, Equivocation, Appeal to Popularity
  - Appeal to Tradition, Appeal to Ignorance, Appeal to Emotion
  - Red Herring, Straw Man

- Unacceptable Premises
  - Begging the Question, False Dilemma
  - Slippery Slope, Hasty Generalization
  - Faulty Analogy

- Deductive Reasoning: Propositional Logic
  - Connectives and Truth Values
  - Conjunction, Disjunction, Negation
  - Conditional, Checking for Validity
  - Simple Arguments, Tricky Arguments
  - Streamlined Evaluation

- Deductive Reasoning: Categorical Logic
  - Statements and Classes
  - Translations and Standard Form
  - Terms, Quantifiers
  - Diagramming Categorical Statements
  - Sizing up Categorical Syllogisms

- Inductive Reasons
  - Enumerative Induction
  - Sample Size, Representativeness, Opinion Polls
  - Analogical Induction
  - Casual Arguments, Testing for Causes
  - Casual Confusions

- Inference to the Best Explanation
  - Explanations and Inference
  - Theories and Consistency
  - Theories and Criteria
  - Testability, Fruitfulness, Scope, Simplicity
  - Conservatism

- Judging Scientific Theories
  - Science and Not Science
  - The Scientific method, Testing Scientific Theories
  - Judging Scientific Theories
  - Copernicus versus Ptolemy, Evolution Versus Creationism
  - Science and Weird Theories
  - Making Weird Mistakes
  - Leaping to the Weirdest Theory, Mixing What Seems with What is
  - Misunderstanding the Possibilities
  - Judging Weird Theories
  - Crop Circles, Talking with the Dead

RECOMMENDED BOOKS:

1. Vaughn Lewis, 2005, The Power of Critical Thinking, Oxford University Press.
2. Paulsen David W., Cederblom Jerry: 2000, Critical Reasoning, Wadsworth
3. Restall Greg. 2005, Logic: An Introduction, Routledge

INTRODUCTION TO PHILOSOPY 3 Credit Hrs

- Definition and Nature of Philosophy
- Theory of Knowledge
  - Opinion and Knowledge
  - Plato, the Republic Selection
  - Knowledge through Reason
  - Descartes Meditation on First Philosophy
  - Knowledge through Experience
  - Hume an Inquiry concerning Human Understanding (Selection)
  - Experience Structured by the Mind
  - Kant Critique of Pure Reason (Selection
  - Knowing and Doing
  - James Pragmatism (Selection)
  - Knowledge and Emotion
  - Jaggar Love and Knowledge (Selection)

- Philosophy of Religion
  - Proving that Existence of God
  - Anselm, Aquinas, Paley, Dawkins (Selection)
  - Justifying Religious Beliefs
  - Pascal Pensees (Selection)
  - James The will to Believe Selection
  - Freud the Future of An Illusion (Selection)
  - Confronting the Problems of Evil
  - Mackie Evil and Omnipotence (Complete)
  - Hick Philosophy of Religion (Selection)

- Metaphysics
  - Idealism and Materialism
  - Berkeley Three Dialogues Between Hylas and Pholonous (Selection)
  - Armstrong Naturalism, Materialism and First Philosophy (Selection)
  - The Mid-Body Problem
  - Descartes Meditations on First Philosophy (Selection)
  - O'Hear Introduction to the Philosophy of Science (Selection)
  - Dennett The Origins of Selves (Complete)
  - Pali Canon (Selection)
  - Penelhum Religion and Rationality (Selection)

- Freedom to Choose
  - Libertarianism
  - James The Dilemma of Determinism (Selection)
  - Taylor Metaphysics (Selection)
  - Determinism
  - Hospers Meaning and Free Will (Selection)
  - Skinner Walden Two (Selection)
  - Compatibilism
  - Stace Religion and the Modern Mind (Selection)
  - Radhakrishnan Indian Philosophy (Selection)

- Ethics
  - Fulfilling Human Nature
  - Aristotle Nicomachean Ethics (selection)
  - Loving God
  - Augustine The Morals of the Catholic Church and the City of God (Selection)
  - Following Natural Law
  - Aquinas Summa Theologiae (Selection)
  - Doing One's Duty
  - Kant Fundamental Principles of the Metaphysics of Morals (Selection)
  - Maximizing Utility
  - Mill Utilitarianism (Selection)
  - Turning Values of Upside Down
  - Nietzsche Human, All too Human and Beyond Good and Evil (Selection)
  - Creating Ourselves
  - Sartre Existentialism is a Humanism (Selection)
  - Hearing the Feminine Voice
  - Gilligan In a Different Voice (Selection)
  - Baier What do Women Want in a Moral Theory (Selection)

- Political and Social Philosophy
  - The State as Natural
  - Plato the Republic (Selection)
  - Aristotle Politics (Selection)
  - The State as a Social Contract
  - Hobbes Philosophical Rudiments Concerning Government and Society (Selection)
  - Locke the Second Treatise of Government (Selection)
  - Liberty of the Individual
  - Mill On Liberty (Selection)
  - Alienation in Capitalism
  - Marx Economic and Philosophic Manuscripts of 1844 (Selection)
  - Justice and Social Trust

- Rawls A Theory of Justice (Selection)
- Nozick Anarchy, State, and Utopia (Selection)
- Held Rights and Goods (Selection)
- Women in Society
- Wollstonecraft A Vindication of the Rights of Women (Selection)
- De Behaviour The Second Sex (Selection)
- The Value of Philosophy
- Russel The Problems of Philosophy (Selection)
- Midgley Philosophical Plumbing (Selection)

RECOMMENDED BOOKS:

1. Abel Donald C., Stump Samuel Enoch, 2002. Elements of Philosophy: An Introduction, 4th Ed. McGraw-Hill.
2. Scruton Roger, 2001. A short History of Modern Philosophy, 2nd Edition Routledge.